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PERFORMANCE LIGHTING DESIGN

SECOND EDITION

HOW TO LIGHT FOR THE STAGE, CONCERTS AND LIVE EVENTS

NICK MORAN

BLOOMSBURY

Performance Lighting Design

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How to Light for the Stage, Concerts and Live Events

Second Edition

Nick Moran

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Introduction

Lighting design: light in space

Can you remember a particularly spectacular sunset? Remember how light turned the everyday into the extraordinary. Light can reveal and alter the form and colour of things, and affect our emotions too. With a waft of mist or haze, it can even give form and colour to the air! On the stage, designed light can guide our senses as we experience the performance, helping us to see better, and often to hear better too, and to experience the performance more deeply.

As audience, we sit in the dark while the performers perform in light, the boundary between us and them defined by light that at the same time guides and frames our vision. Light allows us to imagine the same stage space as many different spaces, or to see a confined space on a huge open stage. And it can transform a space in the blink of an eye or imperceptibly slowly over a whole performance.

Like most areas of design, it requires a mix of craft and art. The material of this art form is not the charcoal or the paint of the traditional fine artist, but ephemeral and untouchable light. Performance lighting design has no real lasting product to be hung in a gallery. It does not even really exist independently of the performance it was made to support, but at its best it does aspire to be art – it can change the way we experience life.

Almost always, creating a lighting design for a live performance requires collaborations. Lighting designers (or LDs) work closely with directors, writers, composers, choreographers and set, costume, sound and projection designers. They work with the performers too, and with the stage management team who look after them. They work with the venue technicians and lighting crew, follow-spot operators, lighting programmers, engineers and other experts from the venue and from the manufacturer or hire company supporting the equipment. On larger shows the lighting team may include assistants, associates and other helpers. Then there's the production manager, technical management, stage crew, fly crew, riggers . . . the list goes on. These collaborations are often best when all the team members share the same vision of the piece, and can take some ownership of that.

On many productions, at least as much of the lighting designer's time and effort is spent managing relations with all these people as with actually lighting the stage.

Performance lighting design: from craft towards art

What needs to be learned about the craft of performance lighting design? Apart from learning how best you manage all the people mentioned above (sometimes without them realizing that you are doing it), learning any craft begins with understanding the medium and the tools. In Chapter 1 we'll look at the basic properties of light – our medium. In Chapter 2 we'll look at

fixtures, lanterns, instruments, lights, call them what you will – they are the things that produce the light with which we paint the stage picture. In Chapter 3 we'll look at how we see light and how to describe it technically and creatively. As an aspiring LD you will need to know what different lighting fixtures do well and what they won't do, and how to make the best use of each type in a range of different situations.

Then there is the matter of organizing those fixtures into a lighting rig, something that often needs an understanding of structures and weights, as well as the visual communication of technical ideas (drafting lighting plans). Getting light out of each fixture when you ask for it usually comes next, for which you need some understanding of electrical power, dimmers, control cables – and some skill managing lots of numbers. All of this is the focus of Chapter 7. Next comes the task of focusing your fixtures, either by direct human effort – often at the top of a ladder or something like it – or by remote control from the moving light console. Whatever the method, the LD needs to make sure the right quality of light will fall in the places we want it too – keeping distractions down to a minimum. We'll look at this in Chapter 8.

In large-scale theatre, opera and dance, or on major world tours of bands like The Rolling Stones, there are teams of assistants doing much of the slog and preparation required before the LD sits down to work with light onstage. In almost every other production setting the LD will need to get involved in at least some of these practical matters. Sometimes there will be a production electrician or theatre lighting department to help with hanging, plugging, colouring and focusing the rig – but sometimes you as the LD will have to do some or all of this alone, and still remain an artist, in your own head and in the eyes of the rest of the creative team!

But there is a big gap here. Before you start to plan a lighting rig, you really need to know what the piece – the play, opera, dance work or concert set – needs light for. In Chapters 4, 5 and 6, we will look at gaining an understanding of this through reading the play, listening to the music, watching the rehearsals, working with models and drawings of the set, samples of the costumes and other materials used, and, probably most importantly, talking about the piece with the rest of the creative team. In short – creative inspiration. With this you can begin to think about what quality of light you will need where at key moments of the piece and when and how should the light onstage change through the performance. And from these ideas you can begin to draw up a rig plan, a focus plot and your cue sheets.

Once you understand what you want light to do for the piece, hopefully based on a vision shared with the rest of the creative team, and you have a focused lighting rig, then you can start creating your lighting design on the stage – and making art. This is the focus of Chapters 9 and 10.

Chapter 11 looks at analysing the finished design in order to make the next one better, going on to look at how you might begin to build a career as a lighting professional. Finally, Chapter 12 looks at how possible future developments might impact on what we do, and hopefully offers some food for thought.

Performance lighting design as art

Lighting design for the stage is a relatively modern practice – at least in the way we most often use the term today. The role of lighting designer, with an independent creative responsibility, began to emerge in the USA in the early

years of the twentieth century. In Britain, the first person to be credited as lighting designer in a theatre programme was Michael Northen, in 1952.[1] Before that, and in many places for a good time after that too, the director or producer worked with the theatre's electrician to create the lighting for theatre productions. Fifty years earlier, however, there were already theatre makers who could see the potential of light onstage to do much more than simply illuminate the scene and tell the audience where the star was. The big names of this era were Edward Gordon Craig (1872–1966), the son of a famous English theatre actress, and Swiss scenographer Adolphe Appia (1862–1928), who worked with the great opera composer Richard Wagner. The influence of these two men on Western theatre has been profound – even if many theatre makers are not even aware of the changes they initiated and further encouraged in their writings. If you are going to take lighting design for theatre seriously you really need to find out more about both these men. Here is a short extract from Appia's writing:

> In itself, lighting is an element that can produce unlimited effects; restored to its freedom . . . (from being servant to the tyranny of painting) . . . it becomes for us what the palette is for the painter. Every combination of colours is within its scope. Through productions that can be simple or complex, stationary or shifting, through partial obstruction, through varying gradations of transparency, etc., we can obtain an infinite number of modulations. In this way lighting offers us a means of, so to speak, externalising a large number of the colours and shapes that painting freezes onto flats, and of extending them, brought alive through space. The actor no longer moves in front of painted lights and shadows, but is plunged into an atmosphere intended for him. Performers will easily understand just how far reaching this kind of reform would be.[2]

Appia was arguing for an end to flat stage settings of painted cloths that decorated the stages at this time ('the tyranny of painting'). He hated the lack of connection between this two-dimensional painted world and the three-dimensional actors performing in front of it. He wanted a stage where design evoked an equally three-dimensional world of performance in which the actors moved, lived and performed. And he knew how important light would be in creating this world. Appia was writing at a time when the lighting technology needed to realize his vision hardly existed. Through his emphasis on performer, space and light, all at the expense of the traditional representational setting, Appia has directly and indirectly influenced many theatre and performance movements. Most importantly for us, his ideas set stage lighting on to a road where it could aspire to more than simply illumination. He raises the possibility, even the expectation, that light in performance will be required to communicate with the audience, to evoke time and place, to signify doom and dread, delight and wonder, as well as to guide the attention of the audience through the performance. Appia perhaps foresaw that, as performance lighting designers, our work should have a

[1] Scott Palmer's *Light: Readings in Theatre Practice* (Palgrave, 2013) and Yaron Abulafia's *The Art of Light on Stage* (Routledge, 2016) both include concise and informative introductions to the history of light in theatre.
[2] Adolphe Appia, *actor – space – light* (John Calder Books, 1982), p. 43. Quoted from *La Mise en Scène du Drame Wagnérien*, published around 1895; translator unattributed.

scenographic[3] function as well as an illuminating function. Working with others, we can manipulate how the space of performance is seen by the audience. In a drama, by controlling the length, colour and position of shadows to mimic nature we can evoke changes in the time of day, the seasons or the apparent weather conditions. We can change the perceived colour of objects, costumes, even the performers, for dramaturgical reasons or to add to the visual variety of the show. We can isolate a performer with a follow-spot or a 'special', perhaps for a song in a musical or an opera, or for psychological reasons in a play. On the concert stage and elsewhere, we can change the apparent height of the stage using beams and a little haze, or turn a single space into several different 'rooms', by simply choosing to turn on different fixtures at different times. The competent performance LD, working with the right tools, can truly 'write the stage' as a scenographer.

Realism, naturalism and reality onstage

It is important to remember through this discussion that what we are doing in performance is not a literal representation of reality. Even in the most naturalistic domestic drama, the performance space is not the four walled room it pretends to be, any more than the actors are the people they present to the audience using the words in the script. It is extremely unlikely that the scene will be successfully lit using only the domestic fixtures that would be present in the 'real' room. Even if we were to attempt this, it would lead to a very dull room. It just would not be 'dramatic'. The British actor, director and playwright Steven Berkoff has said that real life is theatre watered down, or perhaps theatre is life turned up to 11! Performance is about heightened reality and pretending, whether it is *Hamlet* or the latest pop sensation. The international theatre maker Peter Brook has commented that while film deals in similes, theatre's concern is primarily with metaphor. It is not usually possible (or useful) to create an exact reproduction of sunlight or moonlight on an indoor stage. For most live performance the single viewpoint of film is not available, and generally neither is the possibility of a strict imitation of 'natural' light. The performance LD will have to evoke sunlight or moonlight, to present the motivated essence of sunlight or moonlight, rather than try to create an accurate facsimile. This should be taken up as a challenge rather than a limitation. How much more powerful is the boiled-down essence of a thing than that same thing diluted? Theatre is a distillation of real life, to mangle Berkoff. This is, after all, how much of performance works – a play such as Shakespeare's *Hamlet* distils many tempestuous months of a young man's life into a few hours. Scenography for live performance – whether as set design, costume, sound or lighting design, blocking or any other aspect – usually works best when it evokes the essence of a thing rather than when it tries to show a literally accurate reproduction of the thing.

It's not just for LDs

This book is not just aimed at those interested in working as lighting designers. There is lots of information to help directors and other designers

[3] 'Scenography comes from the Greek *skēnographia*. It is sometimes translated as scene-painting or perspective drawing, but is now more frequently understood to mean scenic writing. The term is . . . used to describe a more integrated reading of performance that recognizes the role played by all the elements of a production in the creation of meaning.' From J. Collins and A. Nisbet (eds), *Theatre and Performance Design* (Routledge, 2010).

working with an LD to understand the potential and the limitations of light in live performance. There is also information for anyone working to help a LD realize their lighting design, as crew, as programmer or as production manager. There are some sections in boxes that go into practical details, outlining safe practice, for example, and extensive footnotes explaining technical terms and offering asides that aim to help put parts of the main text into context.

1

An introduction to light in performance

An introduction to light

To talk about lighting design in performance we first need to establish some common ground. Don't worry if some of this does not make complete sense to you at first reading – the nature of light and colour has engaged some of the brightest scientists, artists and philosophers over the centuries. Use this chapter as a quick introduction to some ways of talking about light and colour that are useful to performance practitioners. Come back to it if there are discussions later in the book where the science gets confusing, or if in your practice you need to remind yourself or someone else of some basic facts about light.

Many people working with light in performance will already be familiar with the material covered in this chapter. To those of you with a detailed knowledge of the science of light, I apologize for some of the necessary approximations made here.

What is light?

We can't see light. Everything we see, we see because light, emitted or reflected from objects, enters our eyes and forms images there on the retina – at the back of each eyeball. These images stimulate the specialized receptors in the retina (cells known as rods and cones), which send signals to be processed by various parts of the brain.

But you can't see light as it travels from source to lit object, or from lit object to eye. What we see is the object, not the light – even though we only see the object because light from it is entering our eyes. It might help to think about how we see the objects in space. In the night sky, we can see stars, the moon and a lot of dark space in between. Much of that space is 'full' of light from the sun (and other stars), but it cannot be seen until there is an object for the light to bounce off, such as the moon.

Whenever we do see beams of light, for example in a shaft of sunlight through storm clouds or the beams of light above a concert stage, what we are seeing is light reflected from dust, mist, rain or smoke particles. A beam of light is invisible until it hits something – if you can see it, it is hitting something.

For several centuries scientists argued about what kind of stuff light is. In some scientific experiments it behaves like a wave, in some like a particle. In some philosophies, it travelled with a knowable speed, in others it appeared instantaneously. In the early years of the twentieth century, the wonderful duality that is quantum

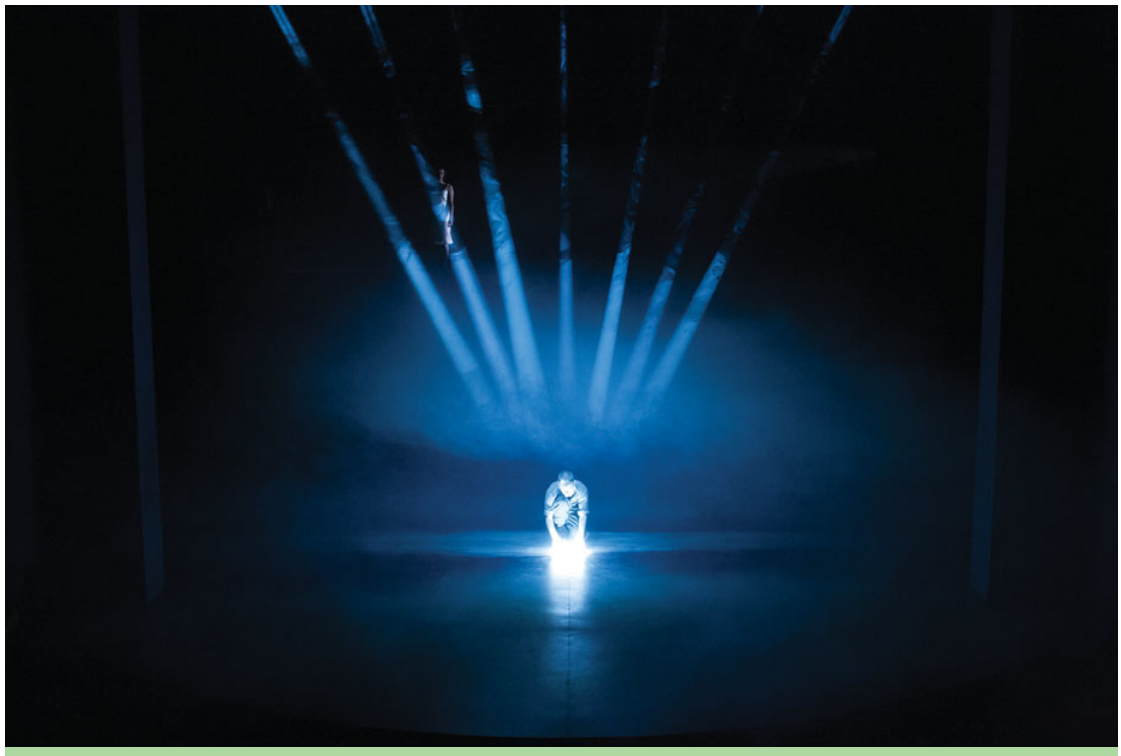


Figure 1 Light made visible by haze in a production of *Woyzeck*. (Lighting by Dan Hill.)

mechanics began to give us a description of light that combined its particle-like and wave-like properties.

For our purposes, light is best described as a wave. Like radio waves and x-rays, it is a part of the electromagnetic spectrum. White light is a mix of many different wavelengths of light. For someone with good colour vision, each different narrow band of wavelengths is perceived as a different colour from the rainbow. (By analogy, if we could see in the radio wavebands, each radio station would be a different colour.) We can use special filters to separate out quite narrow wavelength bands, which we then see as light of a single pure colour. This is like the filters in a radio tuner separating out individual radio stations. Visible light has wavelengths between about 700 nanometres at the lower energy red end of the spectrum down to about 400 nanometres at the higher energy violet end of the spectrum. A nanometre is one millionth of a millimetre. To give this some scale, the average width of a human hair is about 250,000 nanometres. The wavelength of the blue light called cyan, which is about 500 nanometres, is 500 times smaller than a human hair.

Scientists talk about the speed of light in a vacuum (about 0.3 billion metres per second) as being a constant known as 'c' – as in Einstein's famous equation $E = mc^2$. When light is not travelling in a vacuum it is slowed down – slightly. In the glass of a prism the average speed is about 0.2 billion metres per second. However, when light passes through almost any material, some wavelengths of light are slowed down more than others. Violet and blue light slow

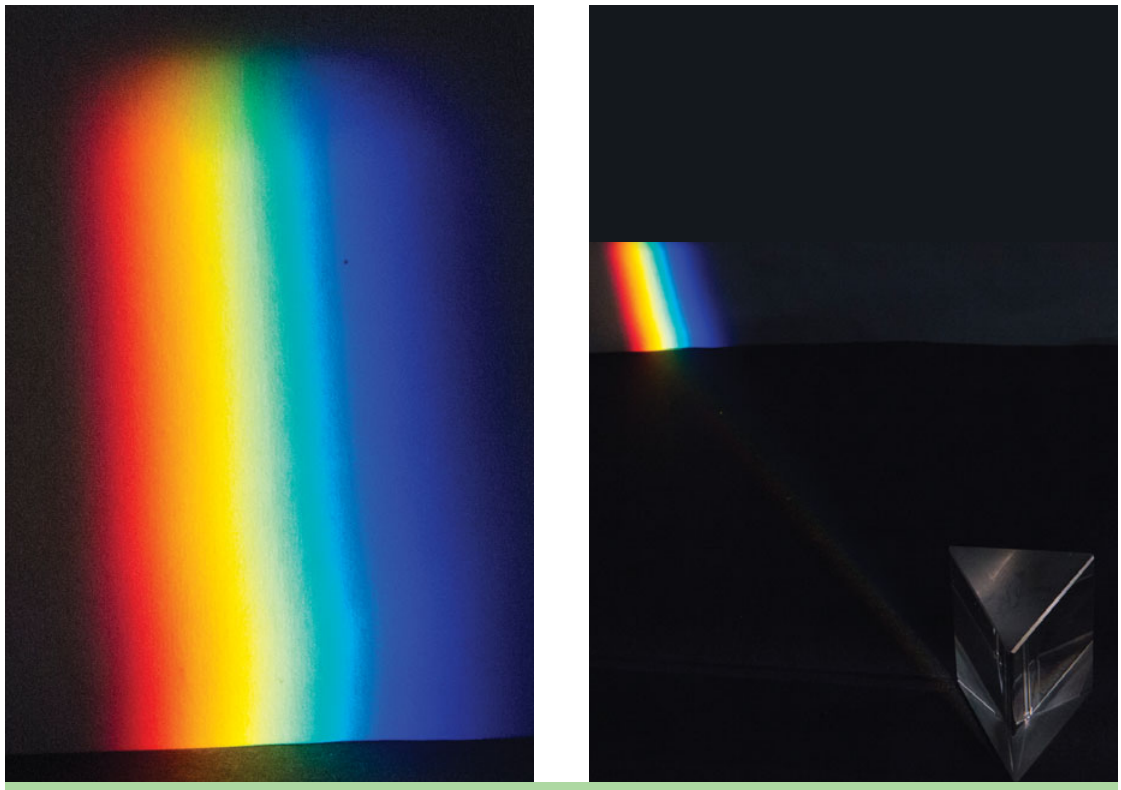


Figure 2 The spectrum produced by refraction of white light through a glass prism. Each different component colour is bent to a different extent as it passes through the glass; the shorter the wavelength, the more bending occurs.

down more than amber and red light. As a result, white light travelling through a prism becomes split up into its component wavelength bands – its colours. This was famously demonstrated by the seventeenth-century scientist and philosopher Isaac Newton.

It is not just a glass prism that can do this, but any substance where different wavelengths of light pass through at different speeds – this includes the raindrops that give us rainbows, and simple lenses. Unless we take special care, every time light of mixed wavelengths goes through a lens, it will begin to split up into its component colours. This is called chromatic aberration. It can be overcome by coating lenses, and by using special glass, and this is what makers of good quality camera lenses do, but there are limits. For most lantern manufacturers, the extra cost of coating lenses is prohibitive, so most theatre lanterns have a limit to the sharpness of beam they can produce, especially when using white or near white light.

How light travels

Light travels in straight lines. Actually even this is not strictly true. Lenses bend light, and in astrophysics very dense objects, such as black holes, can be detected from earth, because they bend starlight in their immense gravitational fields. Light also appears to bend around the earth under certain conditions, but this is a

phenomenon due to reflection and refraction in layers of air of different densities which causes effects like mirages. So, these special cases aside, in the performance space, light travels in straight lines. It will not bend around corners or under a ceiling. But it does bounce!

Light is bounced, or reflected, from surfaces in two ways: specular reflection from shiny surfaces such as highly polished metal, and diffuse reflection from objects that are not shiny. We can think of light waves carrying information about the objects that emitted them, and the objects that reflect them. The information about an object carried by light includes its shape, colour and relative position. It is the information carried by light, information our eyes and brain interpret, that allows us to discover properties of the objects we see.

In specular reflection (illustrated in Figure 3) the light bounces off the surface losing little of the information it carried as it hit the surface. We can see a reflection in a mirror, and less perfectly in other shiny surfaces, because the information carried by the light hitting the mirror remains intact as it leaves the mirror and travels towards our eyes. Light bounces off the reflective surface at the same angle that it strikes the reflective surface – just like a ball (with no spin) bouncing off a wall.

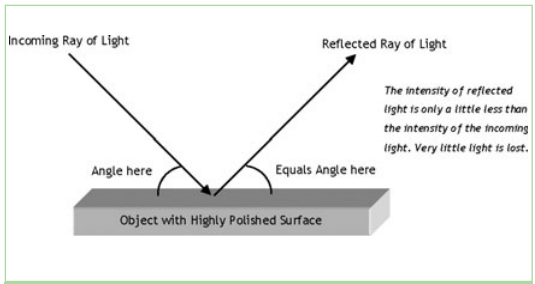

Incoming Ray of Light
Reflected Ray of Light
The intensity of reflected light is only a little less than the intensity of the incoming light. Very little light is lost.
Angle here
Equals Angle here
Object with Highly Polished Surface

Figure 3 Diagram of specular reflection, for example from a perfect mirror.

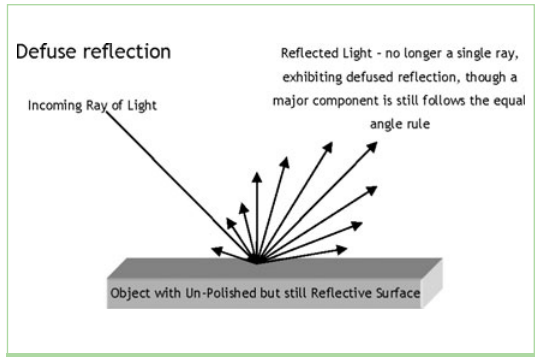

Defuse reflection
Reflected Light - no longer a single ray, exhibiting defused reflection, though a major component is still follows the equal angle rule
Incoming Ray of Light
Object with Un-Polished but still Reflective Surface

Figure 4 Diagram of diffuse reflection, for example from a shiny floor.

In fact light can only behave in this way. Diffuse reflection, where the information carried by the beam of light is disrupted and bits of the beam end up travelling in different directions, is actually specular reflection from a rough surface. The surface may not look rough, but remember we said that the wavelength of light was about 500 times smaller than a human hair. At that level even polished paintwork can look pretty rough!

The amount of light reflected by a surface depends mostly on how shiny or dull the object is. The shinier the object, the more light is reflected, hence shiny objects look brighter than dull ones. But shiny objects reflect light primarily in one direction, at the same angle to a line perpendicular to the reflective surface as incoming light. Meanwhile dull objects, whose surfaces exhibit only specular reflection, bounce less light, but in more directions. This means that shiny things will look bright from some angles and less bright from others, while dull things will normally look more or less the same brightness from most angles.

White and coloured light and pigments

Not all white light is the same. The white light from the sun is different at different times of day and

different times of year. The white light from a traditional incandescent light bulb is different from the white light from a theatre lantern, and different again from the white light of a fluorescent strip light. It can be difficult to establish this with our eyes because, unlike a camera, the human eye does not see absolute colour; we see colours relatively. This is one consequence of the ways in which information from our eyes is processed by our brains. You can, however, see the difference between all these different 'white' lights when you see them side by side. For example, look at the colour of white paper in the beam of a theatre lantern and a domestic lamp. We say the different sources each have a have different colour temperature, and we will need to come back to this several times in the coming chapters.

If we illuminate a coloured object with white light, the object reflects back to us only the colour of light we see, absorbing all the other colours. If we see a red object in daylight, the object reflects only the red light. All the other wavelengths of light, the orange, yellow, green, blue and indigo, are absorbed by the surface of the object.

If we illuminate our red object with only blue light of a narrow band of wavelengths, the object will look black, because no red light is available

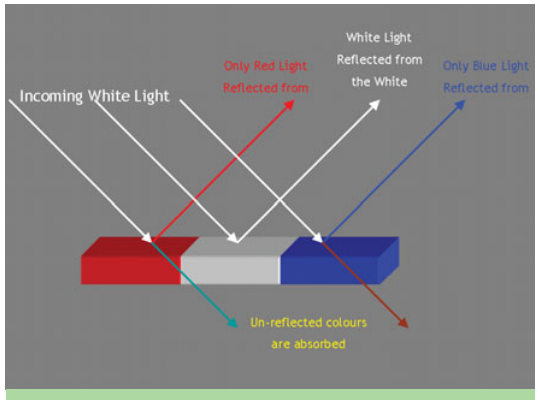

Incoming White Light
Only Red Light Reflected from
White Light Reflected from the White
Only Blue Light Reflected from
Un-reflected colours are absorbed

Figure 5 White light reflected from a multi-coloured object.

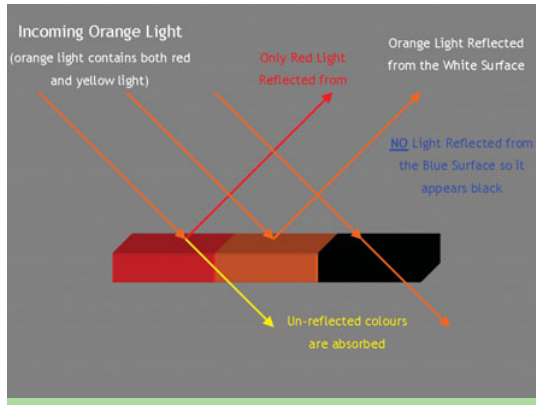

Incoming Orange Light
(orange light contains both red and yellow light)
Only Red Light Reflected from
Orange Light Reflected from the White Surface
NO Light Reflected from the Blue Surface so it appears black
Un-reflected colours are absorbed

Figure 6 Orange light reflected from a multi-coloured surface. In coloured light, white objects take on the colour of the light. When no light of a particular colour is present, objects of that colour appear black.

to be reflected off the surface back to our eyes. There are some interesting tricks to be done with coloured light and coloured objects.

Most green pigments reflect both yellow and blue light, so a green object may well appear yellow in a 'red' light. However if that 'red' light is very pure and has no yellow in it the green object will look black. Even if the 'red' light has some yellow (as it almost certainly will have onstage) if there is nothing to reflect yellow light in the green pigment of the object, it will again look black. Confusing isn't it – but this can explain why some of these experiments may not work for you and why sometimes we get surprising results onstage.

We see the colour of objects like those in Figures 5 and 6 because of their pigment. They will remain the same colour even when we change the angle at which we view them. But there is another way in which colour appears on objects, and that is due to minute repeating structures on the surface. In nature, this is what produces the shimmering colours of peacock and pheasant feathers for example. The same effect produces the colours when you look at the playing side of a CD at certain angles. This is

sometimes called *structural colour*. Materials with these properties can be exciting to use onstage, if a little unpredictable.

Light and human perception

When you see something, light, either emitted or reflected from the thing, enters your eyes and causes rod and cone cells to send impulses to your brain. Various areas of your brain process the information, combined with your past experience, to help you make sense of the world.

Unlike a camera, what you see at any particular moment is related to what you have just seen *and*, to a greater or lesser extent, your recent and not so recent experience. One extreme example of this comes from some research using goggles that turned the world upside down. After a relatively short time wearing the special goggles, the subject stops seeing the world upside down. One of the earliest of these experiments was conducted in the 1950s by Erismann and Kohler. If you search YouTube for 'Erismann and Kohler inversion goggles' you can find the films they made.

We have already touched on another more familiar example with colour perception. While the different white lights of a domestic fitting and an un-coloured theatre lantern can both look white in isolation, when seen together it is clear that the domestic light is almost orange in comparison with the theatre light, which in itself looks much less 'white' when compared with full sunlight.

Colour perception can be upset by the use of strongly coloured light or the presence of a large area of contrasting colour. Notice how quickly the colouring effect of even quite heavily tinted sunglasses can wear off as once again the brain part of the eye/brain channel seeks to match current perception with past experience and, for example, render the open sky as basically blue.

The relative nature of visual perception holds for intensity too. Our perception of intensity depends not only on actual intensity but on our immediate prior experience of intensity, and on the intensity of the surrounding visual field. A person going from a bright sunny exterior into an interior with no windows lit by a single domestic fitting is likely to feel almost blind for a short time in what they perceive to be a dark space. If the same person comes into the windowless room from a candle lit cellar, their perception of the intensity level in the room will be quite different.

A summary

If you are now feeling a little dazed, here is a recap of some of the important properties of light:

Except in some very few special circumstances, light travels in straight lines.

Light reflected by a microscopically smooth surface such as a mirror 'bounces' like a ball (without spin) – the angle going in is the same as the angle coming out.

Light reflected by non-shiny objects is likely to go in all possible directions.

White light is a mix of coloured light.

Objects with pigment colour reflect the colour of light we see, and absorb the rest.

Objects with structural colour can change their colour when viewed from different angles.

Objects we see as black are reflecting little or no light.

Anything we can see is either emitting or reflecting light that has entered our eyes.

Light carries information about the objects we can see to our eyes.

Human visual perception is subjective. It depends on both recent and life-long experience.

What makes performance?

Performance is what a performer or performers do. Performance theory looks at interactions between individuals and groups, in day-to-day life as well as in formal planned productions. We can see common elements and differences in these formal and informal performances. In this book we will be considering many different genres of *formal performance*, that is formally organized events, usually performed by trained, professional performers. Formal performance usually happens in a building designed or adapted for performance, usually but not always with a stage or defined performance area. It has become common though in most of the world to provide a technical infrastructure to enable luminaries to be hung, powered and controlled to make performance lighting in these spaces. This technical provision will vary from the very basic few lights and a control board to the sophistication of a modern opera or dance repertory theatre, with many hundreds of fixtures, and many skilled engineers, managers and technicians to make them all work.

Some performance spaces are created just for one production. Of these, some of the most exciting and challenging for performance lighting professionals are spaces in which site-specific theatre is made. On a very different scale, the large concert stages for festivals such as Glastonbury are built for one weekend of concerts, and then taken down and transported to their next temporary home to be rebuilt.

Live music concerts can range from seedy club gigs with a few LED PARs screwed to the ceiling, right up to the monster touring spectaculars of The Rolling Stones and U2 – with lots of different sizes of venue and lighting rig in between. The latest hot indie band, a slick tribute act and the BBC Henry Wood Promenade Concerts (or Proms) in London's Royal Albert Hall are all live music concerts, despite their very different styles of lighting, and each comes with a very different expectation of what that lighting should do.

Large-event lighting, including the spectacular ceremonies associated with major sporting events such as the Olympics, use many of the same techniques as theatre and concert lighting, but on a significantly larger scale. Those in charge of the lighting for these events need to consider both the huge live audience at the event and the millions watching at home on TV. The team involved may well be over one hundred strong. The amount of equipment and power required can be mind boggling. Managing these resources requires the extensive knowledge of some very talented individuals, and many consider those who do this well to be at the pinnacle of performance lighting practice.

Each different genre has its own practical requirements and audience expectations. The audience for a play in a traditional theatre may not have explicit expectations of the performance lighting, but they will normally expect that once the play begins, the stage will be brighter than the auditorium, that they will be able to see the faces of the performers and that they will not 'notice' or be distracted by the lighting. In contrast, the audience at the main stage of a large music festival will expect to be (sometimes literally) dazzled by 'in-your-face' lighting effects, see the lead performers in hard-edged follow-spots and to be brightly illuminated themselves from time to time as they are either asked to join in a chorus, or be recorded by the TV cameras as they cheer between songs.

What is performance lighting?

As we have already seen, we need light to see: light bounces off the objects around us and

enters our eyes, triggering nerves that send signals to the brain and enable us to see the world.

The English language has many expressions involving light: a teacher throws light on a subject; a reporter may help us to understand a situation in a different light or might bring a scandal to light. We talk about people having a light in their eyes or having a smile that lights up their face, or a personality that lights up the room. We talk about the light of experience, and about a person being the light of our life. We talk about the light at the end of the tunnel and about stealing someone's limelight. We use expressions that imply light or its absence, about dawning realization and false dawn, about being in someone's shadow, shadowy worlds and dark forces. Light is a metaphor for understanding, for clarity and clear perception, and for inspiration, for bringing joy, for excitement. Light's absence or reduction is often a metaphor for fear and danger or for hidden action, often with implications of deceit and dishonesty, or sadness and rejection. With this in mind it is clear that light in performance can carry a great deal of signification, on top of its primary function, that of allowing the audiences to see what is going on.

In English we use 'I see' to mean 'I understand', and this is not surprising when we consider how much information healthy human eyes can receive in the right circumstances, that is with adequate light. To see a performance in well-designed light is a step towards understanding it. Whether we mean 'see' literally or metaphorically, the literal light will shape our understanding and interpretation of the performance. It will guide our eyes to focus on certain parts of the performance at certain times; it will illuminate some aspects and shadow others and this will encourage emotional and intellectual responses. These may be heightened through the use or absence of colour, of particular directions of light striking objects and performers, and by structure and composition. The audience is often said to *read* the performance – taking in all the visual, sonic and other information in the very human attempt to 'make sense' of what is going on. Light illuminates this *reading* of performance, both literally and metaphorically.

The language of signs

This idea of *reading* the world around us is linked to the idea of thinking about the world as a set of signs that we interpret to make sense of it. The formal study of this way of interpreting the world is called *semiotics*. It is important to acknowledge that most signs of this sort, however, don't have a fixed or universal meaning. Most signs depend on context for much of their meaning. This is in the nature of signs – almost all signs are imperfect *signifiers*; they don't always communicate as we would wish.

Take, for example, a flaming torch onstage. In the hands of an actor dressed as an athlete in a play about the Olympic Games it carries one set of meanings. Put it in the hand of an actor dressed as a brown-shirted activist in a play about the rise of a dictator and the same object carries a very different set of meanings. Just as the same word can have different meanings in different sentences, the same object can have different meanings in different contexts.

When it comes to light, a square box of light onstage can be *read* as a room – in the right circumstances. We need to set up that kind of sign, so that the audience 'get it'. In the same way, we can set up a particular wash of blue light to be read by the audience as 'night-time', and a different colour to be read as daylight. We just need to work with all the other makers of performance signs – the writer, composer,

director, set and costume designers, sound designer, performers and others – to ensure the context is there to help the audience read our signs in the way we want. And we have to acknowledge that it may still not work – for some or all of the audience.

Light in performance

An audience discovers the performance, informed by light. This is the case whether the performance lighting is designed or not. If the performance lighting is designed well, in harmony with the other elements of the performance, then it will enhance the communication between the performers and their collaborators (writers, designers, directors, composers, choreographers, etc.), and the audience. If the performance lighting does not work with the other signifiers, it will often have a negative impact on communication and therefore on the audience's experience of the performance. If the performance lighting highlights the wrong areas of the performance space or creates excessive and distracting shadows, the attention of the audience may be in the wrong place, or at least not in the place intended by the creators of the production. If the performance lighting fails to get across the time and place of what is happening onstage, perhaps by not making clear the passage of time or a change in location, the audience may be misled, and again the communication with the audience will be diminished. If the performance lighting fails to suitably illuminate the faces of speaking performers, the meaning of the text may be lost.

In the last century, lighting for dramatic theatre was often self-effacing – remaining more or less un-commented upon for much of the audience – and prompting the often heard statement, 'Good lighting is when you don't notice it'. Audience expectations are changing, however. The argument that performance lighting for drama should be unnoticed is losing its once strong grip. In many genres of performance, the audience is increasingly able and willing to dissect what they see and hear on the stage and elsewhere, and to find meanings beyond the surface one presented. Performance lighting can and frequently does play an important role in aiding the production of meaning by the audience. In doing this, it also enhances audience engagement with and enjoyment of live performance. In this way, and in others, the lighting designer has become an important member of the creative team.

Looking natural

What do we mean when we say light looks 'natural' or 'unnatural'? If the creative team for a particular production want to create a quality of 'natural' light for some scenes, the major sources of light need to come from 'natural' angles and be of a natural colour.

In our everyday world we are used to the primary light source being above us. The dominant sources of 'natural' light inside and outside are above our eye line. We have to look up to see them.

In daylight the strongest source of light is the sun, next is the more diffuse light from the sky, and then the light that is reflected or bounced off our surroundings. At night the main source is usually the moon or streetlights, again from above. In most interior spaces, the main light source is also from above us, again with varying amounts of bounce light from walls, floors and ceilings, and other objects in the space. Perhaps there will be subsidiary sources such as task lights and feature spots, but still in most spaces the main light sources will again be above the eye line.

Thinking about colour, the sun's light is a kind of white, a different kind of light depending on the time of day, the weather and the seasons, and where we are in the world. Light from the moon is another different kind of white. Inside, most of the time, light is basically white – though usually a different kind of white to the light outside.

We live in a world where most of the light comes from above the eye line and is basically white so this is what we think of as 'natural' light. This natural light puts shadows below noses and chins, often highlights the tops of objects and people and lets us see colours in a particular way. It is so natural, that unless we look for these (and other) effects, many people don't even notice them – until they are not there. Clearly the lighting practitioner needs to have a keen appreciation of what natural light looks like, and a good knowledge of how to reproduce its effects when required.

If we wish to disrupt the audience's perception, and draw attention to light or the effect it is producing, we need only to introduce 'unnatural' shadows and colours. You may have seen a friend shining a torch onto their face from below. This strong source from below the eye line places the shadows of their features in different, 'unnatural' places. Changes from the natural draw attention to themselves. This is true for shadows, and as we will see for colours too.

Leaning to 'see'

For anyone interested in creating visual imagery, educating the sense of sight will clearly be important. This is sometimes described as the development from passive 'looking' to active 'seeing' (as in 'I see' to indicate understanding). Since the business of a lighting designer is light, and what light illuminates, seeing is clearly going to be important. All performance practitioners need to be aware of how much visual information is potentially available to their audience, and need to hone their skills in both reading the intentional visual cues, and spotting potentially distracting stimuli in order to eliminate them. Those particularly concerned with the visual elements of performance, for example the set, costume and lighting designers, need to be able to help the audience create meaning. This requires us to see with understanding and not just to look.

Fine-art painting: composition and light

It can be difficult to begin a study of light in a constantly changing environment. Perhaps a better way to begin to develop an appreciation of light – both 'natural' and 'unnatural' – is through looking at how fine-art painters and photographers have captured moments of our constantly moving three-dimensional world within a static two-dimensional frame. Fine-art paintings and photographs, especially representational works, offer a way to study a single scene frozen in time.

There are many artists who have displayed a deep understanding of light and composition in their work. Reproductions of many works appear in books and elsewhere. Good-quality poster-sized prints can provide excellent examples for studying the handling of light, as can images from the websites of some galleries. Some of my favourites include examples of Michelangelo's work in the Sistine Chapel, where he uses light in several ways; to help demonstrate physicality and the representation of three dimensions on a flat surface, and frequently as a metaphor. I also find inspiration in much of Rembrandt's work, especially his handling of artificial light sources

inside, for example in *The Blinding of Samson*. Most of the few surviving works by Jan Vermeer depict interiors too; wonderfully balanced compositions, to me almost driven by a cool clear light, often from an unseen source to the left of the picture (or in proscenium theatre terms, 'off-stage right').

There are many other inspiring works from many other periods and styles of art. I have a particular affection for the landscapes of two British artists from the early nineteenth century, J.M.W. Turner and John Constable, both concerned with the play of sunlight and sky, but working in very different styles. In the late nineteenth century, the Impressionist artists were deeply concerned with capturing the play of light in their work. Many worked in a consciously theatrical way. For example, Edgar Degas drew inspiration and subject matter from the Paris Ballet.

Quite apart from the joy of studying these works for their own sake, it is a useful exercise for lighting practitioners to look at a scene in a painting or photograph and make a reasonable guess as to the position and nature of each light source affecting it. Postcard reproductions of paintings can be used to hone this skill.

While these famous, even iconic, works are readily available as reproductions, seeing paintings for real can be more rewarding, and the paintings don't have to be by the great artists to have an impact. It is a good idea for anyone involved in making visual performance to have a knowledge of contemporary and more established art practices, as a reference point for discussions about style and look for a particular production, and this means getting to know the great iconic works, from the past and the present. In addition, for a lighting practitioner, a visit to a gallery or exhibition is more than getting to know a historical style from the works. A more general concern with composition and the handling of light informs active viewing. If you are new to this try these few questions to begin with:

'Where are the light sources within the image?'

'How could that look be reproduced in performance?'

'What do I think is going on in this picture?'

'How have I worked that out?'

'What role is light playing in my reading?'

If you are a newcomer to this way of seeing pictures, you may be surprised to find that many artists cheat with the sources of light, even in highly representational art. It is not unusual to find inconsistencies used for dramatic or narrative effect, or more often for reasons of composition. A lighting designer can sometimes want to do much the same – for example highlighting different areas of the stage from different directions for compositional or practical reasons. A close study of how old masters get away with it can be useful.

Figure 7 One of several paintings by Edgar Degas titled *The Rehearsal*, from between 1873 and 1878. Original in the Fogg Art Museum, Harvard University, MA. The artist uses soft light from the windows, balanced by shadow and reflected light from the room to aid the impression of solid form, especially in his rendering of the dancer's limbs.

Photography

Photography became the primary mode of representational art in the last century. It appears to be much more instantly available to the practitioner and the viewer than painting or drawing. Because of this it is often disregarded as art; after all anyone with a camera can take a photo. This may be true, but some photographers have the ability to consistently produce powerful images, and it is worthwhile investigating what is different about their photographs when compared with the average holiday snap. One of my favourite twentieth-century photographers is Henri Cartier-Bresson, who worked almost exclusively in black and white, in the world outside the studio. His photographs demonstrate a technical proficiency with the tools of his craft, the camera, its lenses and shutter, the film and the techniques of the dark room. But they also demonstrate an ability to connect the viewer with the subject, and to tell a story, and most of that is through choice of subject, and frame – that is composition. On the performance stage, the lighting almost always defines the composition of the stage picture, the centres of interest and the relative importance of background and foreground, the depth of field, the boundaries, the visibility of textures and so on. A study of good photography can help an understanding of how elements combine in powerful ways to communicate more than the sum of their individual parts.

Many lighting designers are keen photographers themselves – both to record their work and for inspiration. There are similarities between photography and lighting design – the same need to balance creative skills with mastering technology, and of course the same basic material – light. Digital photography has considerably reduced the cost of experimenting – it no longer costs so much to take and look at hundreds of shots. Through doing this, you can develop your technical skill with the camera and an eye for composition, in your own photographs as well as in those of others.

If you want to develop seeing by taking photographs, if at all possible get hold of a camera with as much control over focus and exposure as you can afford. This kind of machine may be more difficult to master, but once you have done that, any good photographs you produce will be much more your own work rather than the happy accidents of the 'snapper'. Also take care with the colour temperature or white balance setting – auto white balance is not usually the best choice for anyone interested in recording digital images of performance.

Performance and communication

Performance Studies gives us tools to speak about and analyse how communication takes place between 'stage' and 'audience' in both the highly organized context of, for example, a theatrical production and the less formally organized circumstances of everyday life. In most live performances there is a torrent of information available to those observing the performance. This comes in the form of spoken or sung words, other sounds, and potentially lots and lots of visual information. For the most part, the observers will engage in the apparently natural human instinct to 'make sense' of this information. Just how this happens, how audiences make sense of, or *read*, that information, is a key element of performance studies. Makers of performance, from avant-garde performance artists to Broadway or West End producers, and including designers and performers, will often claim to have an understanding of the ways in which an audience can

read a performance. This may be expressed in the academic language of performance studies or as 'gut instinct' gained over years of trail end error. Whatever the source of the understanding, and however it is expressed, it points to the importance of communication between the makers and the audience of a live performance. The makers of performance need to have some idea of what it is they want to communicate to the audience – even if it is as apparently simple a thing as 'have a good time'!

The stage has been described as a place 'pregnant with possibilities and meaning'. For Western theatre this idea goes back to the beginning of formalized performance on the stage in ancient Greece. The concept also appears in other cultures; the idea of performing musicians or priests/performers opening gateways to possibilities not available in everyday life is common to many cultures. An audience for a live performance is very often eager to read meaning into what they hear and see (and perhaps touch, smell or even taste) onstage, and as makers of that performance we need to be aware of that, and be prepared to engage in the generation of coherent meaning in the performance.

Communication and the role of the lighting designer

For theatre makers working on the creation of performance, perhaps the only guiding principle should be to remember that everything presented to the audience is capable of being read, interpreted and given significance by that audience in their normal human desire to 'make sense' of what they are experiencing. This includes all the elements we present intentionally, as well as those elements that slip in by accident or omission.

The work of the performance lighting designer is often of pivotal importance to successful communication between stage and audience. The visual elements of the performance will be seen only if there is light there. How they are seen (and therefore how they are read by the audience) will be determined largely by how they are lit.

Strong signification from stage lighting is rarely possible without careful collaboration with the director, other designers and the performers. Without rigorous effort to integrate the stage lighting signs with the way the performers move,[1] with the scenic design and with all the other elements of the production, the lighting signs will no longer have the intended signification, and may be read as 'careless mistakes', producing a negative or unsatisfactory reading of the production.

Lighting and audibility

On the dramatic stage, lighting the faces of the actors is almost always the first priority for the lighting designer. Research in the fields of artificial intelligence, language teaching, brain function and from elsewhere have all confirmed as scientific fact what many 'old school' theatre practitioners have been saying for years. We comprehend spoken language with our eyes as well as with our ears.[2] Thanks to science's ability

[1] In performance studies, we use the terms proxemics and kinesics to describe in detail the ways in which a performer makes use of space. See E. Aston and G. Savona, *Theatre as Sign System* (Routledge, 1991) for a good introduction to these topics in the context of semiotics.

[2] I have found useful work on the links between visual and auditory speech recognition and comprehension in journals ranging from *Cognitive Neuroscience* to *Computer Assisted Language Teaching*. For readers who wish to look further into this interesting research field, some key words are 'visual speech' and 'speechreading'.

to map what is going on in our brains, it is now possible to say with some certainty that 'a good view of the speaker's face aids cognitive processing of speech' – in other words, when the audience can see the actor's face, and particularly the area round the mouth, they will be able to process (and therefore understand) what is spoken more quickly than if they cannot see the actor's face. This is not quite the same as 'the audience can't hear if they can't see faces'. After all how would radio plays work if that were true? What some of the research points to is that there are situations where seeing the face significantly improves comprehension. Researchers refer to times when the 'auditory channel is compromised' which usually means there is an amount of background noise or the language pattern is unfamiliar. For a performance environment, this could mean lighting faces becomes especially important when words are spoken over a soundscape or 'background' music, or when the words are not familiar 'everyday' speech we are used to – the blank verse of Shakespeare or the heavily loaded prose of Beckett might both be examples of that. Even in contemporary drama using patterns of speech familiar to the audience, delivered in a quiet space, the chances are the words will be more significant than the chatter of 'everyday' speech. A lighting designer needs to have a really good reason if they are not to light the face of a speaking performer.

Summary

In this first chapter, we have covered a lot of ground; from an introduction to the physics of light, to painters, and fine-art photographers. We have also touched on elements of performance theory and semiotics, which are both fruitful areas for further reading.

The rest of this book concentrates on the art and craft of performance lighting, but this is only a part of the knowledge necessary to become a successful designer of light in performance. There are many other useful areas of study for someone aspiring to work in performance lighting, including a study of music of any and all kinds, abstract art, architecture, history and literature. On top of these, any engaged theatre practitioner needs to have a good understanding of the organizational structures and processors of the genres of performance that particularly interest them.

At best, any single book can only provide a part of the knowledge needed by a practitioner, and there is no substitute for experiment and practical research. Please keep this in mind as you continue through this book.

2

An introduction to the tools of lighting

Overview of a performance lighting system

In live performance, it is usual to want to be able to control the light focused at the stage, to ensure it reveals what the audience should see and hides what the audience should not see, and to make light work for the performance. Designed lighting – like everything else on a stage – is available to the audience to be 'read' as a sign of something. That might be something physical, such as sunlight or the light of a candle, it might be a sign of the time of day or the weather, the approach of night or a coming storm. Light onstage, or more usually changes in light onstage, can also help to signify to the audience psychological mood, perhaps the joy of discovering love or the mounting depression in a condemned cell.

The light for performance most often comes, not from 'naked' light bulbs (usually referred to as lamps by professional lighting practitioners) but from instruments/fixtures/luminaires, which we are able to *focus* – that is to set the instrument so that light is where we want it and not where we don't want it. We can often colour the light, add texture and sometimes make other adjustments to its quality. We usually have a number of fixtures together called the *lighting rig*.

Most often we will want the light onstage to change over the duration of the performance, even if it is only to become brighter at the beginning and to return to a dark state at the end. For that we need at least one *lighting desk* or *console* linked in some way to each lighting fixture. Figure 1 shows a diagram of a lighting control system.

Lighting instruments

The basic lanterns (or units, fixtures, instruments or luminaires – these words are more or less interchangeable) used in performance lighting fall broadly into three categories:

1 **Floods.** As the name suggests, these units allow light to flood out over a wide angle, determined by the shape of the reflector and of unit itself. Floods have no lens. In performance, their main use is to light large items of scenery, such as back cloths and cycloramas. They are also useful as work light and sometimes as audience light, though the lack of beam control can have disadvantages here.

1. Control signals from the Lighting Desk (Lighting Console) flow through Control Cables to...

A small Touring Dimmer Rack

2a. Dimmers, which then feed controlled electrical power ...

2b. and maybe a signal distribution box, to send information ...

Via Lighting Multicores

3a. to Conventional Lighting Fixtures,

3b. to Automated Fixtures etc,

Electrical Power for the Automated Fixtures etc. gets to the rig via Lighting Multicores too

4. Enabling the Programmer to control all the fixtures in the rig, so that the LD can light the production.

Figure 1 Schematic of a lighting control system.

2 Fresnel[1] **and PC.**[2] Both names refer to the type of lens in these units. They emit a round beam, the size of which is adjusted by moving the reflector, lamp base and lamp closer to (bigger beam) or further away (smaller beam) from the lens. The edge of the beam is 'soft', that is the intensity falls off relatively slowly, so the beams of these lanterns can be joined together relatively easily to make a wash of light, covering a large area. The beams can be shaped by *barn doors* (see Figure 2a). They are used mostly from a short or medium *throw*, or distance from target, between 2m and 12m.

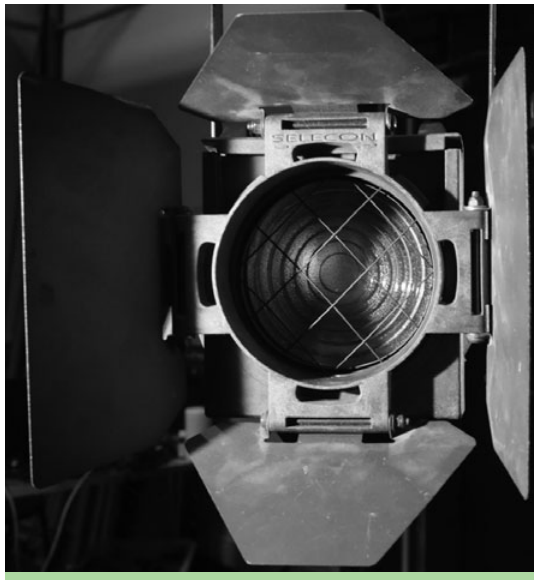


Figure 2a 6-inch Fresnel fixture with a barn door attached (the 6-inch name comes from the diameter of the lens).

2a. PAR 64s.[3] These are a significant sub-type, providing much the same softness of beam and ease of joining beams together as Fresnel and PC units, but without the same ability to change the beam angle. PARs have a fixed beam angle. The PAR lamp is a sealed unit, containing, along with the filament, the reflector and the lens. These determine the beam angle and its shape, and to change beam angle it is necessary to change the lamp rather than simply move a knob. PAR 64s are relatively low-cost, robust lanterns. Their reliability and ease of use has made them a favourite tool of many lighting practitioners. PAR 64s and some other sizes of PAR lamp generally have an oval rather than a round beam, hence there are usually two angles given in data sheets.

Figure 2b The same fixture, showing its soft-edged beam on a black drape. Some automated wash fixtures use Fresnel lenses.

[1] Augustine Fresnel (pronounced *fren-elle* in English), a Frenchman working in the early years of the nineteenth century, invented this type of lens, originally for use in lighthouses. The more steps there are in the lens the more even the intensity across the beam.

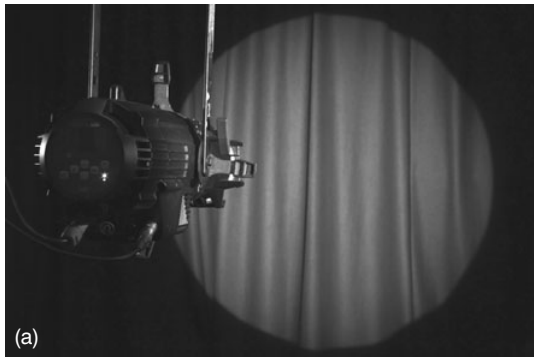
[2] PC in this context stands for pebble convex, a version of the standard plano-convex lens used in many optical devices such as spectacles and simple telescopes. The pebble refers to small bumps on the otherwise flat surface of the lens which help to diffuse the image of the filament and make the edge of the beam softer.

[3] PAR stands for parabolic aluminumized reflector. The number after the PAR is the diameter of lamp in eighths of an inch. Thus a PAR 64 has a lamp which is 8 inches in diameter. There are many other sizes of PAR, and many different uses, both within the entertainment industry and outside it; for example, aircraft landing lights (ACLs) and PAR16s – mini-PARs also known as Birdies.

3 **Profiles.** In traditional proscenium theatres, most of the lanterns used front of house[4] will be profiles. They come in many different forms, but almost all have the common features shown in the diagram. They can produce a hard-edged beam, by which we mean the intensity of the beam drops rapidly to almost nothing at the edge. The beam can be shaped accurately using shutters. Zoom profiles can be adjusted to give various different sizes of beam. They can be focused with a soft edge to enable several to be joined into a single wash of light or with a more defined edge (also called a hard edge) to highlight a single person, object or area. Profiles can be used to project patterns, usually known as gobos (or templates in North America).

Measuring the quality of light

The unseeability of light makes describing it in words difficult. You may have read about how painters or photographers like the particular quality of the light in the South of France or at the golden hour before dusk. You may already recognize these special qualities when you experience them. If you do, that will be very useful to you as LD. You might capture a special quality of light on film, on canvas or in a digital image, but is there anything about that quality that we can measure, in order to better be able to reproduce it?



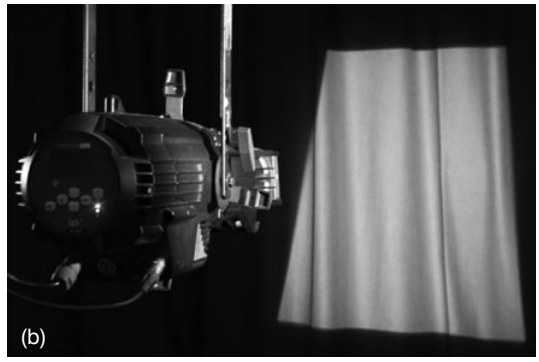


Figure 3a LED profile, all shutters out, sharp beam.

Figure 3b The shutters can be used to shape the beam.

Figure 3c Moving the lens towards or away from the body changes the quality of the edge of the beam from sharp to softer.

[4] Front of house (or FoH) refers to the space where the audience are, as opposed to back stage, the stage house or rear of house. FoH lighting positions in older theatres will normally have been created many years after the theatre was first built, and often are not the ideal solution, merely the least impractical one.

Pre-use checks

Anybody who uses any piece of equipment as part of their job has a moral and legal obligation to check that it is safe to use. The risks associated with using faulty lighting equipment include:

- Electric shock – of a person focusing or otherwise adjusting the instrument, and of a person coming into contact with the metal structure on which it is rigged. This might be a performer or audience member.
- Being struck – by a falling instrument or part of it. Again, those potentially at risk here could include performers and audience.
- Fire – most lighting instruments get hot, even some LED ones. Fires can easily be started by lanterns rigged too close to flammable material.

You will also want to check that the lantern functions as it should; for example, for a profile lantern, that the lenses and all the shutters move as they should, and for a PAR 64, that the lamp rotates, etc. If it is possible to 'flash out', i.e. to plug in the lantern and switch it on to see light coming out of it, then do. Fixing or replacing a lamp in a fixture on the ground is far safer and quicker than doing it at the top of a ladder later.

It is good practice to have some indication of when the equipment last had a detailed inspection and test by a competent person, and when it should be tested again. (In the UK you should find a PAT sticker with a date. PAT stands for portable appliance test.) It is not advisable to use equipment that is beyond its next test date, and it is illegal to use equipment that has been declared unsafe by a competent person.

Here is a list of some basic pre-use checks:

- Check the unit is clean. Not only can dirt inside the lantern cause smoke or even a fire, dusty lanterns are usually dim lanterns – which is not generally what a LD wants.
- Check the case of the unit is undamaged, and that it is not likely to fall apart once it has been rigged. If you are unfamiliar with the unit, ask someone who knows, or get a drawing, for example from the manufacturer's website.
- Check the plug of the unit and the socket it is to be plugged into are compatible, and are both undamaged, with no signs of previous burning or sparking.
- Check the power cable is undamaged, and there are no nicks, frays or cuts in any of the insulation. The point where the cable goes into the unit is often most vulnerable to damage.
- For all lanterns rigged at height, check that the suspension clamp(s) are up to the job. The clamp should be clearly marked with its safe working load (SWL), and you should know the weight of anything you rig. It is good practice to use a secondary suspension device, such as a suitable steel wire safety bond, and you should check that the safety bond is rated to hold the full weight of the unit should the clamp fail.
- Check all accessories are secured to the unit in an appropriate manner, with clips or bonds, and that these do not impede the functioning of the accessory; e.g. you can still turn the barn doors of a Fresnel lantern.
- Once you have checked all the above, plug it in and check it works. It is faster and safer to fix equipment on the ground than at the top of a ladder.

Remember this is the minimum. Checks should become second nature, but never lose their importance, since one mistake can result in serious injury or even death.

DON'T USE EQUIPMENT THAT FAILS THESE BASIC TESTS until the faults have been fixed

Two properties that we can measure are the *colour temperature* and the *colour rendering index* (CRI).

Colour temperature

Colour temperature is a measure of the proportion of the different colours present in the light from a particular source. You are probably familiar with how 'wrong' a photograph can look if you use the wrong white balance setting on a camera. If, for example, you take a shot outside with the camera set on 'tungsten' then the whites will look blue. If you take a shot lit by candles with the camera set on 'daylight' the whites will all look amber. This happens because the colour temperature of white daylight is different from that of candle light. There is proportionally more blue light in daylight than in candle, and proportionally more red in the candle light than in daylight. The objective camera sensor registers this. The reason we don't see this ourselves to anything like the same extent is linked to the subjectivity of human vision (which is covered in a little more detail in Chapter 1).

Colour temperature is measured on the Kelvin scale, which is more usually associated with the scientific measurement of temperature. If you want to look up the physics behind this, search for 'black body radiator'. Strictly speaking, only sources that emit light due to their heat can be said to have a colour temperature, but approximations for other sources (such as fluorescent tubes and some LEDs) prove useful. Warm fluorescent tubes are usually said to have a colour temperature around 4000K and cool ones around 6000K. Light from a candle has a colour temperature of about 2000K, while the noon-day sun ranges between about 5000K and 7000K, depending on the time of year, weather conditions and latitude.

Psychologically, we perceive light with a lower colour temperature, that is with proportionally more red in it than blue, to be warmer than the light of a higher colour temperature, that is with a higher proportion of blue than red. This can be a little confusing, but remember that the physiological effects of light on audiences (and performers) are usually more of our priority than the physics.

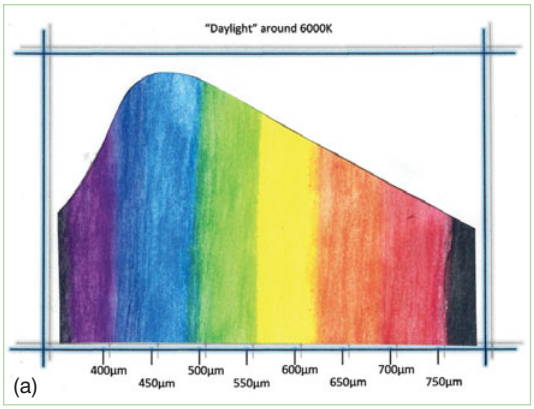
Colour rendering index (CRI)

Colour rendering index (CRI) is a measure of how well a particular light source enables us to see the full range of pigment colour in comparison to sunlight. The number 100 is given to daylight and the closer a source comes to 100 the better it 'renders colour'. Measuring the CRI of a light source involves accurate measurement of the spectrum of the light reflected from a very specific set of pigment samples. The methodology is not without problems. In theory, the closer the CRI is to 100 the better we are able to see the subtle difference between similar shades (though as we have already discussed, other factors come into all aspects of human perception).

Some typical values of colour rendering index

Table 1 Typical values of colour rendering index

Light Source	Typical CRI
Daylight (note – not sunlight)	100 (by definition)
Tungsten Halogen (Incandescent)	Up to 100 – at 100% intensity
Domestic/Industrial Fluorescent	75 to 85
Specialist Fluorescent (for Photography)	85 to 90
Industrial Discharge (e.g. warehouse lighting)	65 to 85
High Quality Discharge (e.g. HMI)	Up to 90
Low Pressure Sodium (orange street lighting)	0 to 18
LED	It depends!



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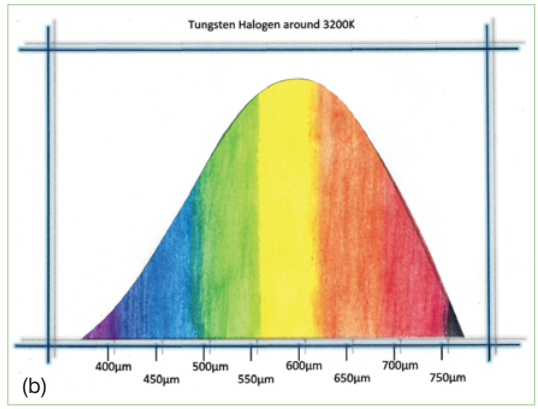

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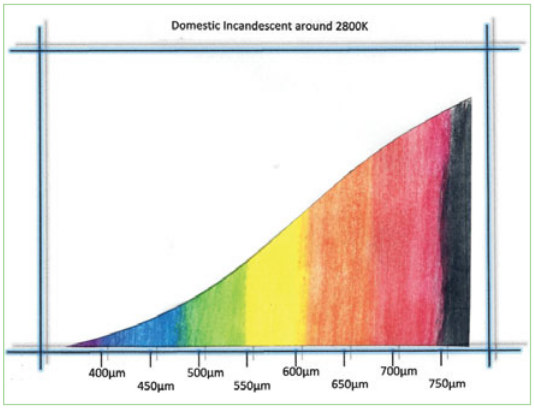


(c)

Figure 4a Daylight 6000K emission graph.

Figure 4b Tungsten halogen emission graph.

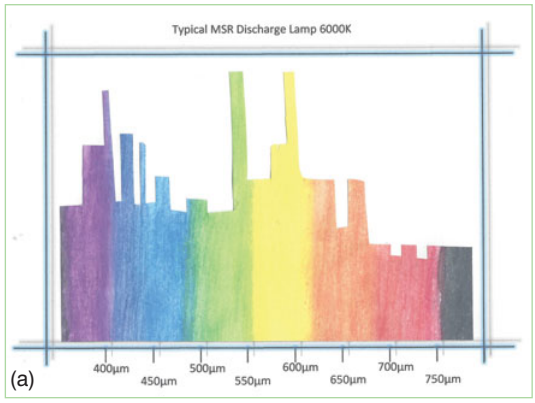
Figure 4c Domestic incandescent graph.

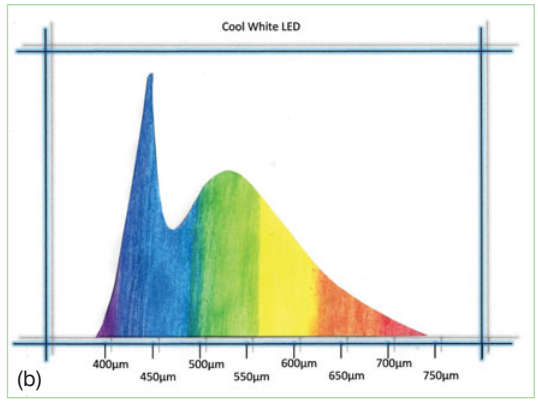
Notes: Sketches showing the approximate proportion of each of the spectral colours in white light from sources at different colour temperatures.

Daylight 'white' has almost twice as much blue in it than red, whereas the tungsten halogen 'white' of conventional theatre fixtures has more or less the same proportion of blue and red, but a much higher proportion of yellow light and the 'white light' from an 'old-fashioned' domestic incandescent light bulb has proportionally very little blue light present.

It is worth bearing in mind that the graph for tungsten halogen 'white' is with the lamp at full intensity. If we dim the lamp to say 50 per cent, the graph would look much more like that of the domestic incandescent lamp. The 'white' would have much more red than blue and look 'warmer'.

One problem with CRI is that it assumes a 'white' source, usually at a specific colour temperature of between 5000K and 6500K, and with a continuous spectrum, similar to those in the rough graphs in Figure 4. Many sources don't fit these criteria, and a high CRI may not be a trustworthy indication of the quality of the light – to human eyes. Any colours largely missing from the source will not be reflected from costumes, set or performers. This is often the case with some fluorescent and so-called 'white' LED lamps. Some colours may look duller under some kinds of 'white' light than they would under tungsten halogen or daylight. Something you might try with friends is looking at tartan cloth (plaid in North America) or some other highly patterned and coloured sample, under a number of lamps with different CRI. Which ones make the colours 'pop'? Which make the colours and pattern look dull? This can help you choose the right source for your project, or at least help you avoid choosing one that will make the costumes look dull!





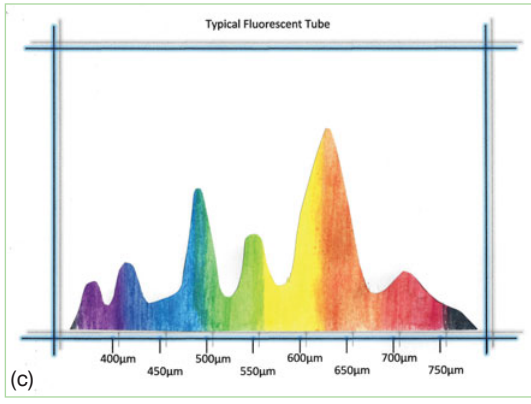


Figure 5a 6000K HMI emission graph.

Figure 5b Fluorescent tube emission graph.

Figure 5c Cool white LED emission graph.

Notes: Three more very approximate representations of the proportion of colours present in: a typical discharge lamp, such as you might have in a moving light; a fluorescent light fitting; and a cool white LED (as opposed for a multi-emitter LED fixture). There are no gaps in any of the graphs, but there are 'spikes'; that is areas where a narrow band of colour is much more present in the light than other colours. This can lead to some unexpected results onstage.

Light sources

So, after this brief diversion into colour temperature and colour rendering, let's have a look at what we can use onstage as a source of light.

Incandescent tungsten halogen (TH) lamps

Tungsten halogen incandescent lamps have been the main source of light onstage since their widespread introduction in the 1970s.[5] They have a colour temperature of approximately 3200K when at 100 per cent intensity, and should have a CRI close to 100. To control the intensity of lanterns with tungsten halogen lamps you need to plug them into dimmers. The light from incandescent lamps becomes warmer as they dim. What an outsider might consider a huge inconvenience has been turned in most cases, to a positive advantage. For example, this property allows a LD to use the same lanterns to act as both a dim warm and a bright cool wash simply by changing the intensity.

Theatre lanterns with incandescent tungsten halogen lamps have been so prevalent for so long that many theatre people refer to them as *conventional* fixtures, or simply *conventionals*. Many LDs have grown up using mostly conven-

[5] Prior to the introduction of tungsten halogen lamps, most theatre lamps ran at a lower colour temperature of around 2800K, very similar to domestic incandescent lamps.

Figure 6a Bright cool lamp.

Notes: An incandescent lamp. The lamp in 6a is at full, the filament is hotter and the light appears cooler. The lamp in 6b is at 25% intensity, the filament is much less hot, but we say the light is warmer!

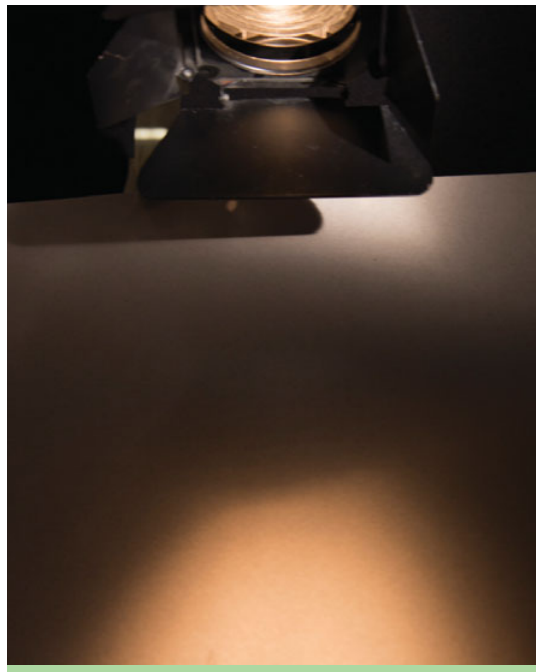


Figure 6b Dim warm lamp.

tional lighting rigs, and are deeply attached to the ways they work. They consider the way they fade in and out to be 'natural', almost organic.

The modern tungsten halogen filament lamp, although much more efficient than its predecessor, is still not a very efficient way to produce light. Much of the electrical energy consumed by a tungsten halogen lamp is 'wasted' as heat. If that were not bad enough, this waste heat often has to be removed from the performance space, consuming more energy in ventilation and air-conditioning plant. Environmental and commercial pressures have already made it almost impossible to use any incandescent lighting in new build commercial premises. Performance lighting maybe safe at the time of writing (2018), but as practitioners looking to the future, we should be aware that the days of rigs with predominantly incandescent lamps will not last for ever. So what else is out there?

Discharge lamps

This is a large category, including some types of lamp that have quite a narrow spectrum, designed for specialist uses. Although performance lighting practitioners do use some of these low CRI lamps, I will focus on lamps designed specifically to produce a high CRI 'white' light.

Most follow-spots, video projectors and moving lights use high CRI discharge lamps. The light comes from a sustained electrical spark, or arc, contained by a quartz glass bulb filled with a tightly controlled mix of gasses. To sustain the spark, these lamps need a purpose-built power supply to convert standard mains

electricity into the correct voltage and current for the lamp. This might be built into the fixture or (for follow-spots) might be external. In any case, do not plug these fixtures into a dimmer.

Rather than the continuous spectrum of colours produced by an incandescent source, the discharge lamps produce a much more 'spiky' spectrum (see Figure 5a). This means that there may be some colours present in the light from a tungsten source that are a lot less present in a discharge source. Generally, they have a colour temperature of around 6000K to 6500K. This means there is a higher proportion of blue light and a lower proportion of yellow, orange and red light than tungsten halogen lamps. Most discharge lamps produce significant amount of ultraviolet[6] light, which has to be filtered out of the light hitting the stage, to avoid causing sunburn.

It is not possible to dim discharge lamps in the same way that incandescent lamps can be dimmed. Instead, the lamp stays on and some form of mechanical shutter opens or closes, either inside the fixture or in front of it. It can be more difficult to fade into or out of a black-out with discharge fixtures since they can't easily reproduce the seemingly organic fade-in and fade-out of tungsten lamps. It's also worth remembering that even with the fixture at 5 per cent intensity onstage the lamp is still at full power. If the audience can see the face of the fixture, this can cause a distraction.

Although discharge lamps are more efficient than incandescent lamps – more of the power going in comes out as light – they still produce waste heat. Most fixtures that use discharge lamps require fans to remove heat from the fixture. Fan noise can make such fixtures unsuitable for venues such as classical concert halls and small studio theatre spaces.

Moving lights with discharge lamps are a very important component of most larger-scale lighting rigs for concerts, musicals, opera and even drama, and as they are almost the only light source used in follow-spots.

Fluorescent lighting

Strictly speaking fluorescent light is another kind of discharge light, only much lower powered than the short arc lamps used in many moving lights and follow-spots. Fluorescent lamps are energy efficient, produce a smooth soft light and with the right technology they can be successfully dimmed from full down to zero. The colour temperature of the light remains constant throughout the range of intensity, unlike incandescent lamps. As with other discharge sources, colour temperature here is an approximation, because to a greater or lesser extent, light from fluorescent lamps does not have the continuous spectrum of an incandescent source (see Figure 5b).

Tubes can be wrapped in coloured 'gels', mounted in banks of three or four, and successfully used to light small to medium-sized cycloramas. Fluorescent-tube fixtures can also be used for set lighting when a soft even light is useful, or built into the set.

The light from these fixtures is diffused, with a wide spread – no beam as such – so it can be hard to contain, resulting in 'spill' illuminating things we would rather stayed in the dark. This diffuse light is good at filling shadows, which can be a positive or a negative, depending on the particular situation. It has a distinctive quality,

[6] The UV light needs to be filtered out before it leaves the fixture. Technicians and others working on units with discharge lamps need to guard against exposure of their eyes and skin to damaging ultraviolet. Severe sunburn and a condition called 'arc eye' will result from careless exposure, for example during maintenance work on discharge fixtures.

which, like the light from discharge sources, when handled appropriately, can be very effective.

LED

At Showlight 2005 in Munich, leading UK-based opera and theatre lighting designer Paule Constable was asked to comment on the latest LED fixtures then available. She said, 'They don't smell right', and most of the people in the room knew what she meant, and agreed with her. How things have changed. From being something with lots of problems back then, LED has become an established light source for performance lighting, offering many advantages over older technologies at an increasingly affordable price. LED, standing for light emitting diode, is probably now the most efficient and potentially most flexible light source available to performance LDs.

LED fixtures almost all use an array of LEDs of different colours to produce light. The crude original units used lots of relatively low-powered LEDs in three colours: usually red, green and blue. These units could produce saturated colours. Some units used 'white' LEDs, to boost the intensity and make it a bit easier to produce less saturated colour. These fixtures produced light that 'didn't smell right', to experienced theatre lighting people. The present generation of LED fixtures tend to use seven or more different colours of LED, and the best are as good as tungsten halogen at colour rendering and dimming.

The basic physics of LEDs goes like this: When electrons meet holes at a particular kind of semiconductor junction they emit photons of light. Early LEDs produced small amounts of almost monochromatic red light. Since then people have done some pretty complex solid state physics to make the junctions produce usable light over a range of frequencies. They have found other ways of making LEDs emit visible light, for example producing white light by coating the lens of UV LEDs with phosphors similar to the ones used on fluorescent tubes.

Although LEDs are very efficient at turning electrical energy into light, it turns out to be quite hard to get rid of the little bit of heat that is generated at each junction. Quite hard, but very necessary, because heat reduces the efficiency of the LEDs and dramatically shortens their life. This is why LED fixtures still produce some heat and why some have fans.

To make LEDs work requires drivers to supply the right current. If you are going to dim the fixtures smoothly, right down to zero per cent, these drivers need to be pretty tricky too, and they too need to be kept cool.

Although electrically very efficient, the materials used in the manufacture of LEDs and their associated drivers do have a significant environmental impact. Just as with discharge lamps, the higher the effective CRI and colour reliability of the eventual fixture, the more expensive the LEDs will be. With LEDs this is because the higher the quality you want, in terms of colour and intensity matching, the more you have to reject at manufacture. Added to this, recycling LEDs and drivers is problematic at the moment, just like recycling any electrical or electronic product.[7] So although you have a light source that is much more electrically efficient than a tungsten halogen or discharge source, it is not without environmental problems.

All that said, the best of the current LED fixtures are extremely useful tools for any LD and are set to become a key component of the way we light the stage in the future.

[7] It is said that there are now e-waste tips where the concentration of gold and the so-called rare earths that are a key component of LEDs and most other electronic circuits is greater than that in the raw ore.

Moving lights

When they first appeared in the late 1970s and early 1980s, moving lights were used primarily for effects, not for lighting performers. Soon they became the tool of choice for live concert lighting and light entertainment TV – both genres heavily dependent on follow-spots to light 'the money', that is the principal performer or performers. The moving lights were used – often very effectively, to create an energized space – while the 'stars' performed in the light of follow-spots. While some moving lights are still used in this way, many large-scale theatre and concert performances use moving lights as their main lighting tool, for lighting the set, for creating exciting effects *and* for lighting the performers.

Large musicals use almost as many moving lights now as they used profile lanterns 20 years ago, while moving lights are increasingly being integrated into the repertory rigs of opera houses and state theatres. It is even possible to see moving lights in fringe venues.

In the live-music industry, almost every venue with its own lighting rig has moving lights. Bands touring the larger venues travel with their own 'movers'. They can even be found above a classical orchestra or choir – provided they are the kind with no fans, since noise is still a problem for these and some other environments.

Figure 7 The Vari*Lite VL5™ is one of the few moving lights that started to appear occasionally in theatre lighting rigs in the late 1980s. Today lighting on many theatre and concert stages is dominated by moving lights, also known as automated lights. As yet, they have no built-in 'intelligence' and need to be told what to do.

Benefits of moving lights

Moving lights can provide many more options to the LD than 'conventional' fixtures. They can take up less space too, if one moving light does the jobs of six conventional fixtures. The original London production of *Miss Saigon* was among the first commercial theatre shows to use moving lights for more than just effect. Lighting designer David Hersey found himself with hardly any space to hang lanterns, most of the grid having been taken up with scenery and bridges. He used the Vari*Lite™ II hard edged moving lights and Vari*Lite™ IV colour wash lights as re-focusable specials and as individual elements of several washes, replacing between them the function of many conventional units, which in any case he had nowhere to hang. In common with many large-scale musicals of the time, there was an extended devising and rehearsal period on the stage, with the rig in place. As the production developed during this period, other advantages of the moving lights became apparent. It was possible for the lighting department to respond almost immediately to blocking and other changes on the stage. Without moving lights to be used as refocusable specials, it would have been necessary for a person to climb up to a lantern and change its colour, position, beam shape or gobo. Now it was only necessary for the LD to

pass a comment to the moving-light programmer, who with a few key strokes could make all the required adjustments from behind the lighting desk in the auditorium. Ideas could be tried out with minimal fuss. Those that worked would be integrated into the show. Those that did not would be abandoned, with minimum of 'wasted' effort.

That was in 1989, and there were fewer than 24 moving lights on the show. In 2014 *Miss Saigon* was revived in London using around 110 moving lights, and according to the revival's lighting designer Bruno Poet, something close to 1,000 lighting cues.

What moving lights do

Let's look first at what all moving lights do. They all move. This may sound simplistic but it's something people sometimes forget. One question worth asking early on is: 'Where can my movers move to?' or 'How many places onstage can each one see?' If you need them to do lots of jobs, you may well need them to 'see' most of the stage – especially if one of those jobs is following a performer or an object. So is there any point in rigging moving lights in positions where they will only ever point at one place? It sometimes turns out that there is; for example when the particular quality of light or colour transition is best produced by a moving light, and you don't mind that from where you want to rig it, the unit can only focus to one place onstage – as long as that is the right place of course.

One of the next things to think about is the quality of light coming out of the unit. Whatever the project, you should aim to be using equipment with a quality of light that you can use. We have already looked at some of the characteristics of light sources. Tungsten halogen has a full spectrum – high CRI – and a colour temperature that decreases as it dims – it gets psychologically warmer. Discharge lamps have a higher colour temperature, which remains the same whatever the intensity. This can make their beams stand out in a tungsten rig, which may be a plus or a pain. However, if you need lots of light from very few fixtures, movers with discharge lamps are generally brighter than the same-sized fixture with any other kind of lamp. It is hard to generalize about the quality of light from LED movers because it varies so much from fixture type to fixture type. If you have not used the ones on offer before, ideally you will want to check them out for yourself.

Colour range and how the fixtures change colour is another key factor to consider. There are several different types of mechanism used for changing colour in the moving lights (and on some static fixtures too). First there are the 'subtractive' methods. In these we start with white light and take out the colours we don't want. On wash movers, and on some of the larger spot movers, dichroic[8] glass filters are used to 'fade' between colours. If we start with a very deep blue and change to pale blue over six seconds, after three seconds the beam might be mid-blue, for example. This ability to change the colour of a beam of light – sometimes imperceptibly slowly, sometimes very quickly – can be a real advantage. Other subtractive colour change methods involve colour wheels (usually internal to the mover, also using dichroic glass) and colour scrollers (usually external, and characteristically found on theatre

[8] Dichroic glass colour filters use thin film technology to produce intense colours, and are frequently used in moving lights. They can be made to allow only very narrow bands of frequencies through, resulting in very pure colours of light. Their production requires stringent quality control, and when this is absent, it can be impossible to match colours in adjacent moving lights.

style lanterns that have been motorized). These change colour in steps rather than in a continuous smooth fade. (It is possible to come pretty close to fading colour with these devices, but it is quite restrictive and often ultimately unsatisfactory.)

LED fixtures almost all use additive colour mixing. That is rather than starting with a white beam and filtering out what you don't want, LED fixtures start with nothing and only add in the colours that you want. Many LED fixtures are able to produce white light that closely resembles the white of several different colour temperatures, as well as a range of colours. (This contributes to arguments about what the CRI of a particular fixture might be and can also make intensity comparisons difficult.) Some fixture types prioritize doing tints very well while others aim to do as wide a range of fully saturated colour as possible.

One of the reasons many LDs chose moving lights, especially in theatre, is to accomplish great fades from colour to colour in the same beam – so, for example, the light can get colder without any (potentially distracting) change in the position of the shadow. High-quality static LED fixtures are now frequently chosen to do just this, almost like a moving light that doesn't move.

Another thing to consider is the lens system (or optics), and beam shaping. How many gobos[9] are available and how many of them rotate could be important in deciding on a particular unit for an effects-heavy show. The presence and accuracy of beam-shaping shutters and 'frost' effects will be important for other shows. Most movers offer a zoom function – especially useful for lanterns at the side of a stage whose targets may be close on their own side or far away on the opposite side of stage. Many offer some kind of adjustment to the beam edge and quality in addition to zooming. However, the compact design of some units seems to lead to limitations in this area.

Some LED fixtures may appear to have no optics. In fact, they have swapped the single large lens or lens system for individual lenses on each emitter. What is often important with these fixtures, just as with most others, is how the beam stops – what happens at the edge of the beam? Does it fade out abruptly or gradually, and if gradually, how gradually? Remember that as LDs we want to be able to control the darkness as well as the light, so we don't usually want stray light from the edge of some beam going where it is not wanted.

Several different systems exist to track the position of the performer onstage. Data from the tracking system can be fed into the lighting desk and used to control the position (and other parameters) of moving lights. These systems need to be set up with care, and even then they do not really replace good follow-spot operators, but they can be very effective in some situations.

Reasons that have little or nothing to do with lighting design may influence whether or not you get to work with moving lights on any given project. Some venues are reluctant to employ the kind of staff who can look after moving lights, while other venues have replaced all their previously fixed units with movers, to reduce the amount of time the lighting staff spend working at height. (This health and safety consideration enabled the Royal Shakespeare Company lighting team to successfully argue to replace much of their overhead rig with movers during the refurbishment of the Royal Shakespeare Theatre at Stratford in 2010.)

[9] A gobo (or template in North America) is used to project a pattern. It is usually placed inside the lantern and so traditionally needed to be able to survive high temperature. This is changing, however, with the introduction of cooler functioning LED lanterns.

Choosing moving lights: some considerations

Table 2 Choosing moving lights

Question?	Potential Response
Is there money in the budget (or do we have contacts to get 'free' movers)?	No point going much further if the answer is no – let's assume it's yes.
Do we have the knowledge available to make best use of movers?	This will usually mean someone who is experienced at putting a system together, someone good at programming moving lights, and someone who can fix them and solve system problems.
Let's assume we have a good enough reason to use movers (which might be a wish to experiment or to achieve some very specific effects) and you can negotiate sufficient resources to allow you to use them. What next? How do we choose which ones to have?	
Colour	
What does the design need in terms of colour? Pale tints and/or deep colour?	This could limit the choice of fixtures since few budget units can produce a full range of tints and saturates well
What colour temperature is 'white'?	For each design, you may or may not want the movers to match the white of the rest of your rig. If the show involves 'live' camera matching colour temperature can become very important.
Are the movers the primary source of colour, or does their colour have to match other colour – from conventional fixtures for example?	If you are going to want the light from the movers to blend in with a number of conventional units, you may need to check how well different fixtures reproduce your favourite conventional colours.
Are you likely to want to fade between colours?	Make sure your units are able to fade colour, and that either you or your programmer knows how to make that fade work the way you want it too.
Movement	
Does the design call for very precise moves, or very smooth slow moves?	Not all the 'quick' fixtures are good at very slow moves, and some are not as good as others at hitting exactly the same spot onstage every night. Ask for a demo in a realistic space, i.e. somewhere with a 'throw' similar to that on your stage.
Do you plan to use performer tracking?	Some units work much better than others, partly to do with speed of response, but also to do with range of movement. If at all possible, try out the system with a range of movers before you commit.
Size and Weight	
How much space have you got to hang the equipment in? How much weight will the rigging position take safely?	Some moving lights are big and heavy. You – or someone you trust – will need to find out if they will fit where you want them and if the rigging position can carry the weight!
What else is hanging on the same lighting bar, truss or other rigging position?	A lighting bar or truss with a mix of fixture types hanging on it can be hard to hide with masking, particularly if some fixtures are much longer than others.

Noise	
Establish how important quiet operation is to others involved in the production – even rock 'n' roll performers have been known to complain about the noise of the moving lights (and the fans in dimmers and amps)!	There are usually at least two separate issues: noise produced when the units move (or change colour/gobo, etc.) and background fan noise. As ever, the best advice is to be prepared, you may have to fight to keep your 'noisy' lights – but you may also lose.
Do the fixtures run in a quiet mode? If so what other restrictions does this put on the fixture?	Part of being prepared is knowing stuff like this. If you can quote the noise reduction in dB, it shows you are at least taking an interest in the problem.
Beam	
Gobos: How many? Glass or metal? If glass, black and white or full colour (or any of the other options in between)? How much will they cost, and how long will they take to be delivered?	Different moving lights have different ways of mounting gobos, need gobos of different sizes and sometimes different materials. Don't assume gobos from one sort of fixture will fit in another, or that if they do the resulting image will be the same.
Beam size: Moving lights will usually need to be useful over a large part of the performance area – so the throw will change. Can your movers cope?	Beam size can be adjusted by 'zoom' and by 'iris'. Zooming concentrates the intensity into a smaller beam, while irising just cuts down the size. If you have significant differences in required throw distances for a single fixture, zooming is much better.
Does the design call for shutters?	How precise will they need to be, and how repeatable? How easy is it to adjust them on the chosen control system? How will the programmer see to make the adjustments? Some shows have used a camera to give the programmer a bird's-eye view of what they are doing onstage.

This brief table by no means covers everything you need to think about when choosing moving lights for a show. It is always wise to ask for a demonstration of any equipment you are not completely familiar with. Take advice – it is likely others you can contact have experience of the kit you propose to use – and find out what the kit can and cannot do, what it does well and what poorly, how much noise it really makes, how long the lamps last, how well they survive touring, etc. Decide what is important – no fixture made is ideal for every role, so you will need to decide what is most important for the realization of each lighting design and for the production as a whole. It is not a simple choice to decide to base a lighting design on moving lights. Time will be used differently – often less time focusing but more time creating lighting cues – and with the right preparation (and that includes making sure the rest of the creative team understand the implications of working with moving lights) problems can be minimized.

Programming moving lights

Most performance lighting is *plotted* with *cues states* during rehearsals. This is when the LD, hopefully working in collaboration with other members of the creative team, uses the lighting rig to create performance lighting in the performance space. It is usual for a lighting *cue state* to have a defined time in the piece where it happens, called the *cue point*. This *cue point* may be *called* by a stage manager following a script or score (as in the UK and US theatre tradition) or *taken* by the lighting operator, who has a good knowledge of the show (as in live music concert lighting). Making sure the lighting does what the LD requires at each cue point and throughout the show is usually accomplished by storing each cue state in a computer-controlled lighting desk, and then playing them back on command during the performance. The storing of each cue state, that is all the control information required

to reproduce that lighting state from the lighting rig, including the intensity of each lantern, any colour, pattern or position changes and the time each change should take, is referred to as programming. Whenever the lighting rig has colour changers, moving lights or certain other devices, it is usually necessary to *preset* these; that is, to make sure they are ready to do whatever the cue state requires *before* the intensity is faded up. This is also part of programming, as is maintaining a back-up up of all the stored information, and ensuring the production can continue to happen as designed, with replacement units, in new venues or with a different cast.

Imagine a lighting control system with just 12 dimmers, each with at least one lantern. No other technology – no colour changers, no gobo rotators, no remotely controlled movement. imagine that the lighting desk is very limited, and will only let us set intensity levels of full, half and zero. Even with this small limited lighting system, to try out every possible cue state, at the rate of one state per second, would take more than six days constant plotting!

Imagine how many possible states there are in a more realistic lighting system, even without moving lights – and we have not even begun to talk about transitions and the variables of both *cue time* and *cue placement*, both of which can have a significant impact on the effectiveness of performance lighting. Once we do introduce moving lights into the rig, the possibilities, and technical complications are multiplied many times. It is usual in these circumstances for the LD to delegate some of the control of these myriad possibilities to others, the first of these being the *lighting programmer*. At best, the lighting programmer provides the LD with a link between their artistic vision of the light for each moment of the performance – and its technical realization. To do this the LD and programmer must establish a good working relationship. This can allow the LD working in the performance space to free themselves from the constraints of thinking channel numbers, colour numbers and exactly how an effect can be executed, to focus maximum attention on collaboration with the rest of the creative team – for example the director, other designers and the choreographer – and the appropriateness of the light at each moment of performance. This does not absolve the LD of the need to have a good knowledge of the lighting rig and what it is doing, but it does mean that they need not be tied to a single position in the auditorium during lighting rehearsals, or to merely receiving and interpreting instructions from the director.

Specials and washes

Now we know what some of the lanterns are called, it is time to try and define a few more terms commonly used in performance lighting, starting with two that have crept into the text already: wash and special. Many lighting designs are made up of washes and specials. Unfortunately, like so many terms we have come across already, and others we have yet to meet, these two important concepts in performance lighting do not have universally defined meanings, and you may find many disagreements about what either means in detail. In general terms, a wash illuminates a broad area while a special illuminates a smaller one. Most often, a wash is made up of several instruments or lanterns working together, while a special is most often the effect of a single instrument.

Imagine a lighting design for a play. The LD may employ washes of differing colour and differing angle to the stage to help to signify the changes in place and time through the story. For example, cool open washes for the open air

Figure 8 In this scene from the play *Market Boy* at the Royal Central School of Speech and Drama, the two characters in the foreground are about to fight. The cool light from high-side follow-spots picks them out from the rest of the performers, who are lit in more general washes of warm light. (Lighting by Ben Jacobs.)

times and places. Warm more contained washes would help signify interior. Alongside the lanterns creating the washes, the LD may have specials, lanterns with a particular function, perhaps to pick out a performer for a key speech or action, or to project a single gobo (or template). Each scene will normally require more than one wash. It is normal to think about a wash being light from just one direction, or at least to appear to be from just one direction, and it usually needs to be balanced by at least one other wash from a complementary direction.

The lanterns that make up a wash may be referred to as a *system* (although again this word may have slightly different meanings for different practitioners). Since it is likely that the LD will often want to use all the component lanterns of a particular system together, control of their intensity may be linked together in a *group*, which is also the name most lighting desks have for several channels under a single controller.

By appropriate planning, the LD can often use elements of the wash as specials from time to time, highlighting smaller areas of the stage by carefully controlling the relative intensity of each lantern in the wash group. While the *group* control enables the whole wash to be adjusted quickly, individual control allows the LD to be more subtle, and often to make each unit perform more than one role. In order to do this though, each lantern needs to have its own dimmer and control channel.

Figure 9 In this scene from *Mad Forest*, the performers are each lit only by their own special for a particular effect. Note how small differences in the angle of incidence from pool to pool, the colour of each costume, and the way each performer holds their head and body result in quite different rendering of each performer.

Key light and fill

An alternative way to think about constructing the lit scene onstage involves the terms *key light* and *fill*, borrowed from lighting for camera. Like special and wash, there is no fixed definition of what we mean by these terms in theatre lighting. Often the term key light is used for the main source of light in a scene and/or the apparent 'natural' source, such as light from a window. The term *motivating source* or *motivating light* is also used too.

This usually strong and evident source of light may be a single fixture or a whole array, a wash from a single direction. Generally, strong key light creates deep shadows, and in order for the audience (or camera) to see into those shadows we will add some fill light. The amount and direction of fill determines how much of what is in the shadow of the key light is revealed and how much stays hidden. This can be used to great effect by a skilled LD.

Traditional key light for natural-looking camera shots comes from above and behind the camera. Cinema styles such as film noir, however, put the key light to one side of the shot, creating an effect something like the chiaroscuro of Renaissance painters such as Rembrandt, Leonardo da Vinci and Caravaggio. This style of lighting has inspired many theatre LDs to use strong sources from the side of the stage and even from behind the performers as their key or motivating light for a scene, carefully adding selective fill to reveal just enough of what is in the shadows.

Lighting for camera is generally done to achieve an effect from a single point of view – the camera – whereas generally in theatre we need to make the lit scene work for multiple points of view. As a consequence, we can't usually be quite as purist with stage lighting as it is possible to be with lighting for camera. The concept of key and fill, however, is a very useful approach to lighting for the stage. It is also one of the few more widely understood ways of talking about light with non-specialists such as directors and set designers.

Learning how to use the tools

Chapter 1 looked at some useful properties of light, at communication between the stage and the audience in performance, and at learning to see and understand rather than just to look. This chapter has looked at some of the tools used to realize performance lighting design: different lanterns with their different beam pattern and different uses, different lamp technologies and some of their pros and cons. It has also introduced us to the first member of the LD's team – the programmer.

Lighting design is about light; controlling its quality, quantity and its signifying potential. To do this effectively needs the ability to see light through the effect it has on the world, and it needs the knowledge of how light is produced, controlled and modified.

Just as some sculptors learn to 'see' their sculpture in the stone before they ever take a chisel to it, so it is useful for a performance lighting designer to see the lighting state in their mind's eye before it is created onstage. This can be especially important when time to make the work is in short supply!

Sometimes, though, a fine artist 'takes a line for a walk' to paraphrase Paul Klee, an artist working in the first half of the twentieth century. This can only happen once the artist has become confident with the tool making the line. There are times when as a LD you do this too: you take the light for a walk. Discover what your rig will do in this space. As well as making those things you planned and saw in your mind's eye, you discover unexpected delights, new things along the way, that work for the production.

3

Describing performance lighting

Figure 1 *Dilemma of a Ghost* by Ama Ata Aidoo, co-produced by Border Crossings and the National Theatre of Ghana at the Africa Centre, London, in 2007.

Describing and controlling light

It can be hard to describe light and therefore hard to discuss it, but it is not impossible. Finding ways to discuss light, what it does as well as what it looks like, should be important for writers and directors, choreographers, set and costume designers and many others, as well as for lighting people.

LDs working in live performance often need to develop two ways of talking about

their specialist subject – the specialist language used among fellow lighting practitioners and a more general language used with other members of the creative team. We have already come across some specialist terms, such as profile and Fresnel, and some ways to talk about light in more general language, such as key light and wash. This chapter introduces some more examples of both types of language.

We are going to be talking a lot about light as a sign onstage and about signification more generally in this chapter.

We are also going to be talking a lot about visual acuity – that is how accurately we can see what we are looking at. While accuracy of this kind is not always what works best in a lighting design, the term will help us talk about how light can help or hinder the accurate rendering of an object to the human eye.

Intensity, focus, colour, beam and time

The properties of performance light at any single moment fall relatively easily into four interrelated categories:

Intensity: a measure of how much light is present.

Focus: describes the location of the light in 3D space: where the light comes from and what it hits and illuminates on the way to its target, how it strikes the target and what happens afterwards – especially in terms of shadows cast and other things illuminated. This use of focus should not be confused with the sharpness or softness of image.

Colour: We can use several different techniques to alter the colour of the light onstage, and we know that different kinds of lamp produce different 'whites'.

Beam: including edge, pattern across the beam and light quality of the beam. The main difference between the output of different fixture types can often be described in terms of 'beam'. For example, a conventional profile fixture has a 'flat' beam with 'sharp' edges – i.e. there is relatively even intensity across the beam and at the edge the intensity drops off very quickly. In contrast, the beam of a conventional Fresnel fixture is 'peaky' with a soft edge – i.e. the intensity drops more or less continuously from the central 'hot-spot' to the indefinite edge of the beam. A conventional PC fixture has a beam somewhere in between these two, flatter than that from most modern Fresnel fixtures but with a less well-defined edge than the beam from a profile fixture.

Describing the light from each fixture in terms of its intensity, focus, colour and beam is something that has become more common in part because that is how many moving light desks, and those who use them, work. It will give us a common language with which to describe the light from conventional lanterns and from moving lights.

Time is the ever present fifth element of performance lighting; onstage, as in nature, light changes over time. Very few live productions keep the same lighting state throughout the performance, and even if they did, for reasons to do with the way the human eye/brain channel works, the audience perception of the light may well change over time. Human perception seems to be largely based on an ability to recognize changes, and changes happen over time, so time affects each of the other properties of light. In performance lighting we talk about the time a change takes to

happen as well as the time at which it starts and/or finishes, but that's for later in the book.

Intensity

Intensity is a measure of how much light is present. We know that for the audience to see anything there must be some light present. For performance lighting we are usually interested in how much light is bouncing off things and available to enter the eye of the audience member (or go down the lens tube of a camera). In the metric system, we measure intensity in lux, the number of lux giving the intensity of light at a particular point.[1] Lumens, the unit most usually quoted for luminaires and projectors, is the total light output at the source. Since the beam from most sources spreads out as it gets further away from its origin, the intensity falls off too, and so an intensity measurement for a single source will decrease the further away you are from the source.

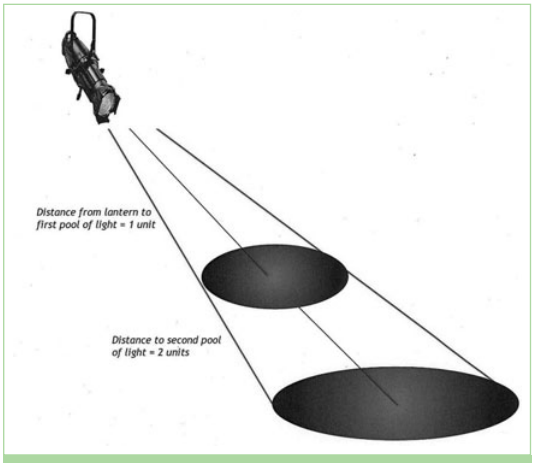


Figure 2 An illustration of the inverse square law for light. When you double the distance from the source to the stage the beam spreads out over an area 4 times larger, so the intensity is only 1/4 of what it was.

Humans can cope with an incredible range of light intensity, from close to 100,000 lux of a snow field on a clear bright day to around 0.0005 lux of a clear moonless night away from urban centres. Unlike cameras, humans perceive relative intensity not absolute intensity – we reference intensity to what has gone before, and it takes some time for our eyes to become accustomed to radically different levels of intensity. If you went quickly from the 100,000 lux snow field into a normally lit room, at say 300 lux, you would perceive the room to be very dark. If on the other hand you came into the room from a moonless starlit night, you would perceive it to be painfully bright.

Although we can operate in a huge range of light intensity, we can't see detail in objects of very different intensities at the same time. Our visual perception will attempt to set its sensitivity to the average intensity level of what we are looking at. This is not the same as the average intensity level of everything we can see at once – which we will call the visual field. We can clearly see a bright image in an otherwise dark visual field, even if that image makes up only a small proportion of everything we are looking at. This is often the case when we watch a stage show from the back of a large theatre, or a rock show from the back of a sports stadium. However, within the area of audience focus – the stage in the large theatre above for example – we need to control the relative intensity, that is the contrast.[2] If there is too much contrast onstage our eyes will not be able to cope, and we will not be able to see detail

[1] The equivalent unit in the imperial system is the foot-candle. One foot-candle is about 10 lux.

[2] Compared to most camera technologies humans can tolerate a relatively high level of contrast within our visual field. Take a look at shadows against a bright sky on the screen of most digital cameras, and your eye will see more detail in the shadow than the camera will.

in both the brightest parts or the darkest parts. (This is of course how we can make part of the stage disappear by making other parts of it much brighter.)

Intensity: glare, distraction and directing audience attention

Although we can cope with a wide range of intensity within the visual field, if there are particularly bright spots, especially if these appear small in the visual field, it creates discomfort. The effect is known as glare, and most people will have experienced it at some time or another, looking into low sunlight or very bright car headlights on a dark road. In extreme cases glare can cause physical pain, but more often it is just unpleasant and reduces visual acuity – not usually helpful to the lighting practitioner. Glare can result from any number of sources in the performance environment, from lanterns shining into the eyes of audience, either intentionally or unintentionally, from highly reflective surfaces on the set or costume 'catching' the light, or from extraneous light sources, such as the gap between the colour frame holding a dark gel and the lantern on some units (particularly PAR cans) or from poorly implemented emergency lighting.

Our visual systems have evolved with a good ability to see detail in the centre of the visual field, and a refined ability to detect movement at the periphery of our vision,[3] a reason for dimming the house lights and lighting the stage. Everything else being equal, we use the part of our vision most able to see detail to examine the brightest part of the visual field. The focus of visual attention is normally directed to where it is brightest so long as the contrast is not so great that it creates glare. This makes the ability to selectively control intensity hugely important in performance lighting design. We can use selective control of intensity to direct attention within the performance area, to point the attention of the audience towards the particular area of the stage we want them to focus on.

The technique of directing the spectator's attention by using selective intensity is extensively used in the field of fine art, notably by some of the old masters of painting. Look at Renaissance paintings of interiors for the way in which the masters handle the depiction of light and shadow, and use it to draw attention to the main subject, and then to broaden the attention of the spectator into the surrounding shadows.

Our attention may be directed by even small increases in relative intensity. At the same time, we can be easily distracted by relatively low points of illumination at the edge of the visual field, especially so when the point is flickering. It follows that performance lighting needs to be concerned with control of relative intensity across the performance area, and the elimination of distractions in the visual field of the audience, both within individual scenes and from scene to scene through the performance.

Intensity as a signifier

In nature, we take many signals from the intensity of the light surrounding us. For example, we are used to night being darker than day outside. For anybody who is tuned into the changes in natural light, perhaps because they work outdoors or

[3] This is said to have been evolutionarily useful to our distant ancestors, both when hunting and when being attacked. Whatever the evolutionary origins, it is very unhelpful when members of the audience are distracted by the peripheral sight of an usher's torch in the middle of an important speech from the stage.

take a lot of photographs, there will be many more signals. The darkening that heralds a storm, the brightness of midday against the lower intensity of early morning light, the bright intensity of direct sunlight in an open space or more diffused daylight reflected and diffused from many tall buildings in a city's financial district, or a different kind of diffusion through trees in a forest.

Inside buildings, light intensity gives other signals. Think about the different ways intensity is used in fast-food outlets and romantic restaurants. Lower-intensity light can be seen as romantic in some settings, or as threatening in others. High intensity can be used to help signify clean and efficient in some public spaces, or cold and uncompromising in others.

What often gives the major clue to a change of time, place or location onstage is a change in intensity. When resources are in short supply (and often even when they are not), changes in intensity may have to carry most of the signification of time and place, and of mood. In nature, there are other properties of the light that change along with the intensity – the colour of light at night is different to that in the daytime, the shadows are strong in direct sunlight and weak or absent in diffuse reflected light. The properties of light are interconnected, in the natural world and in performance, yet intensity remains perhaps the strongest single signifier available to the performance LD.

By controlling relative intensity throughout the performance, the LD can use the simple idea of the indexical sign, pointing the audience towards what is important on the stage. They can use variations in intensity across the stage to signify something about how one area relates to other areas. Intensity can be varied through time, and so can be used to signify changes in the relationships between different spaces, or changes in the space as a whole; changes in stage time or location. It also follows that selective use of intensity can define the size of the performance space at any particular moment.

In order to achieve many of these effects we need to be able to separately control the intensity of light in different areas of the performance space. One of the most important decisions to be made in the development of a lighting design concerns the number and shape of these separate areas, and how many areas will be illuminated at each point of the performance.

Focus: the location of light in space[4]

If intensity is about the quantity of light, focus in this context is about which part or parts of the stage the light hits, and the direction or directions from which the light comes. There are two distinct parts to this property.

We will call the direction from which the light comes the angle of incidence. This has a significant effect on our perception of illuminated objects. The angle of incidence of a beam of light on a 'target' object or performer describes the relationship between the direction from which light comes and the direction from which the audience is observing.

The second part I will call the throw. This is to do with where the light originates and the path it takes to the stage – the path between the source of the light and its destination.

[4] The word *focus* is used in several different ways in performance lighting. As well as the present context, it can be used to describe the size, shape and edge quality of the beam from a luminaire, and the point of stage intended to be the centre of audience attention.

Angle of incidence

Lit objects create shadows, and where those shadows fall, their size and their shape depend on the object, and where the light is coming from. Although frequently constrained by the architecture of the performance space, the angle of incidence of the beam to the performance area will usually be one of the most important considerations when the LD comes to decide where each lantern should hang.

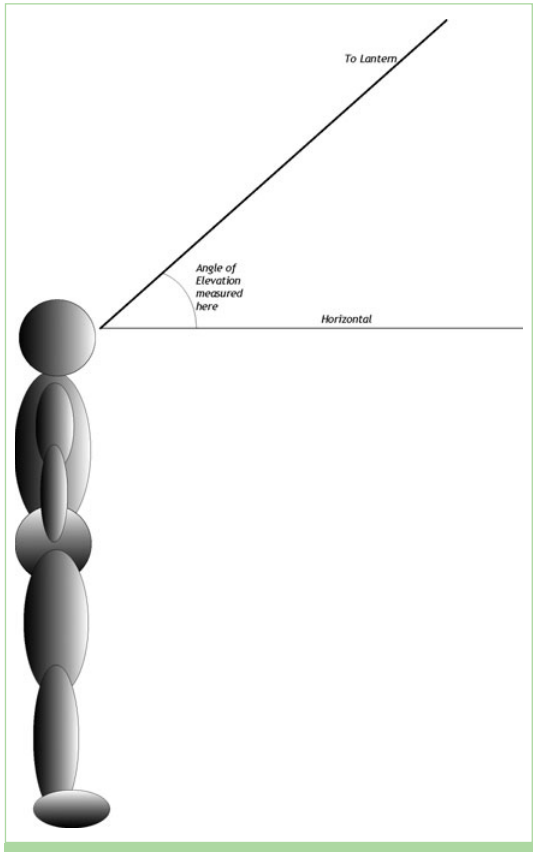


Figure 3a The elevation is one of two angles used to define the angle of incidence of a beam of light relative to a performer facing straight out.

Conventionally, when performance lighting practitioners talk about angles, they refer to the angle of incidence to a performer facing straight out towards the centre of the audience. There are two angles involved: the angle of elevation, taken from the plane of the stage, which is assumed for these purposes to be flat, and the angle the performer would need to turn from looking out to centre, in order to face the lighting position.[5] High or steep angles are close to directly overhead and low or shallow angles are close to or even below the eye line of an upright performer. Back-light comes from behind the performer (180 degrees, or half a turn for the performer). Side-light also known as cross-light comes from the side of a conventional stage (90 degrees or a quarter turn in either direction) and top-light

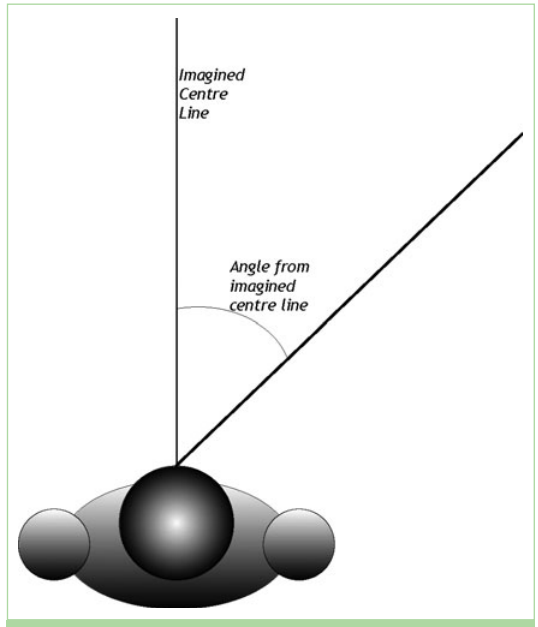


Figure 3b The angle from the centre line is the other one.

[5] I should say that few practitioners get out equipment for measuring angles in these discussions, and any angles mentioned are rough approximations.

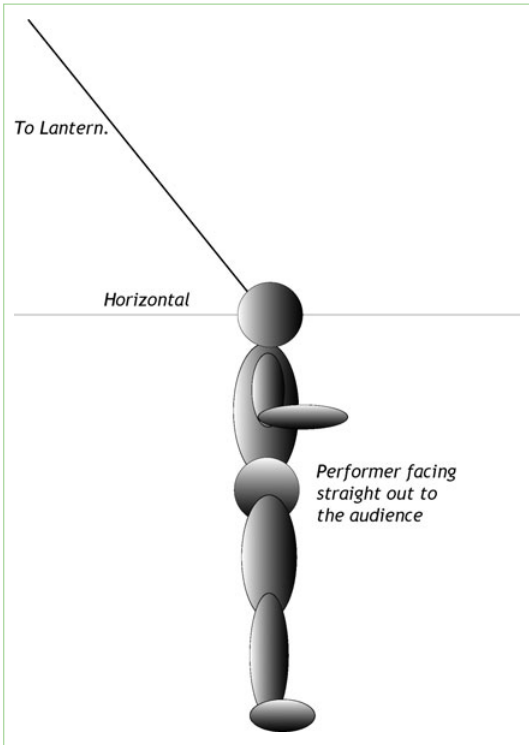


Figure 4a Back-light comes from behind a performer facing the audience (i.e. facing downstage).

from directly above. Up-light or low light comes from well below the performer eye line, for example footlights. All of these terms can be modified or combined to describe different lighting positions relative to the performer or to the performance area. For example, a three-quarter steep back-light for a performer would be in a direction roughly behind their ear, above and further away vertically than horizontally (see Figure 4).

A low cross-light could be to the performer's left or right side; it would probably be below waist level, and may be pointing slightly up. This position has a special name in dance lighting where it is called a 'shin buster', because of the potential hazard the lantern becomes to the legs of those working on the stage.

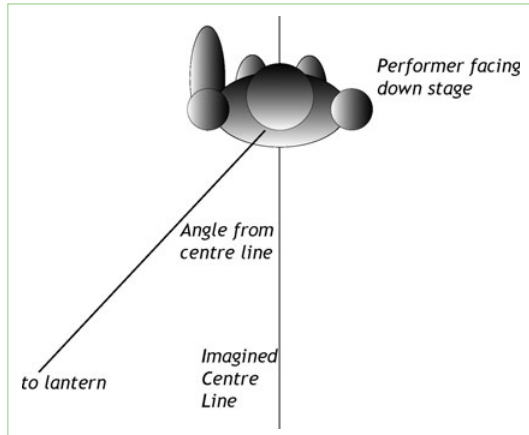


Figure 4b Three-quarter back-light comes over the performer's shoulder and often casts a dramatic shadow in front of them.

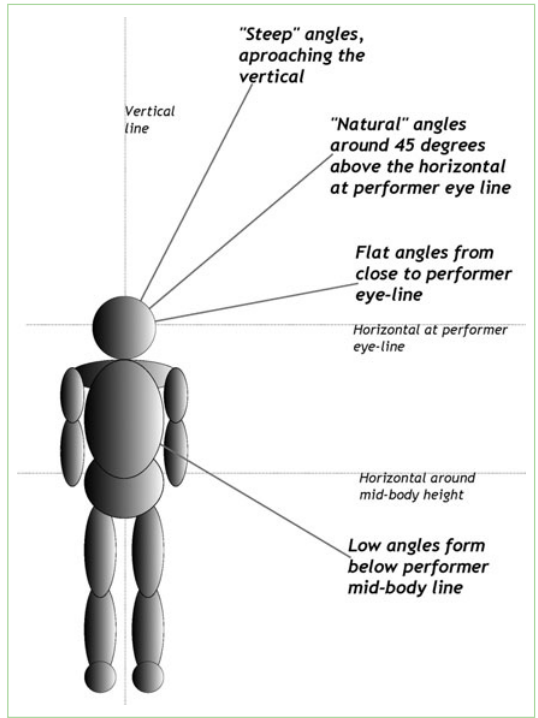

"Steep" angles, aproaching the vertical
Vertical line
"Natural" angles around 45 degrees above the horizontal at performer eye line
Flat angles from close to performer eye-line
Horizontal at performer eye-line
Horizontal around mid-body height
Low angles form below performer mid-body line

Figure 5 More angles of incidence.

The laws of physics dictate that the part of the beam that does not strike the performer continues past that illuminated performer and lights up the stage floor or the set, or whatever else is

in the beam of the lantern. Light from any angle of incidence other than directly above the performer illuminates a larger area of stage floor than the area usable by a performer (see Figure 6). The steeper the angle, the smaller the illuminated area on the stage floor or set, the less 'spill' outside the usefully illuminated area. Steep angles provide more tightly defined areas, which in turn gives the LD a better opportunity to use selective intensity to guide the attention of the audience. However, steep angles often don't illuminate the performer's eyes – the performer's brow creates shadows that stop the light getting to the eyes. A compromise must be made between the steep angle that gives well-defined areas for selective illumination and superior modelling, and the shallower angles that get light into eyes and under noses, helping the audience to see the facial expression of the performers more clearly, but tending to flatten the stage picture, illuminate parts of the stage floor and set that we would prefer to leave unlit, or create potentially distracting shadows.

All these positions assume we are in a more or less traditional proscenium theatre space, or at least that the audience has more or less the same 'end on' view of the performance area. If the performance space is not laid out like this, this description of lighting angles becomes less useful. For example, if the audience surrounds the stage, for a performance in the round, front-light on the performers for some of the audience is back-light for others and side-light for the rest!

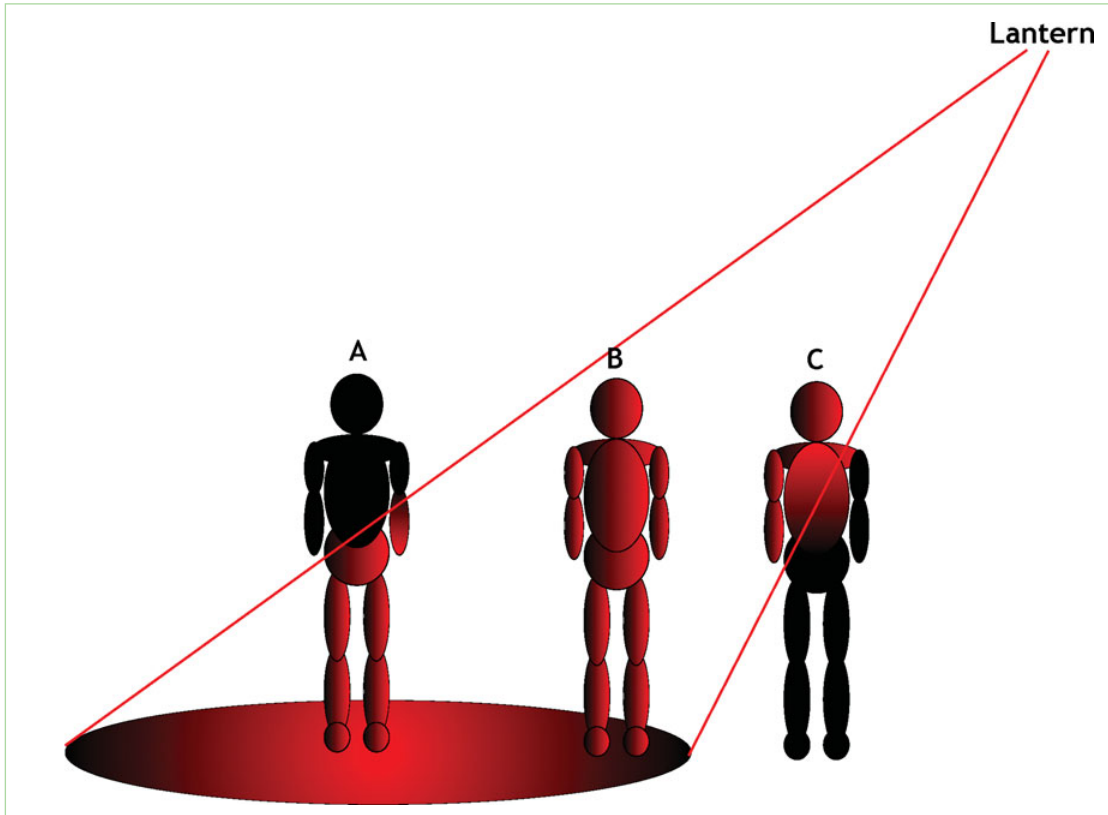


Figure 6 The 'usable' part of the beam is often not near the centre of the beam on the stage floor.

Straight-on front-lighting

Some of the first lighting positions installed for electric stage luminaires were on the front of the circles and galleries of the nineteenth-century playhouses. This is a good position from which to give a more or less natural look on the faces, but it does little to model the body. As originally installed in most theatres, light from these 'circle-front' positions complemented the footlight, which had until then worked almost alone to light the performers. Light from above their heads helps audiences to see performers' eyes and mouths clearly, so long as the angle is not too steep, and the performer is facing them. If front-light is from too shallow an angle, it can lead to large distracting shadows on the set. Shallow front-light used in isolation tends to flatten the stage picture.

Three-quarter front-light

The ideal position from which to light people onstage was for many years considered to be about 45 degrees up from horizontal and about 45 degrees to either side of the centre line of the stage and the auditorium.[6] Many nineteenth-century theatres have had adaptations to take theatre lanterns built in to the ends of the top gallery seating area (or the gallery boxes in traditional playhouses). Almost all proscenium theatres built with electric light for the stage in mind have these lighting positions designed in. For much of the twentieth century, this is where front-light for performers' faces came from, and for very good reasons. Light from this direction provides good illumination of the performer's face and a degree of modelling, so it is good for achieving visual acuity. For lighting a performance staged behind the frame of a proscenium, it is often very useful. However, once the area of performance is pushed through the frame of the proscenium, we begin to have a problem. How do we light the performer at the downstage edge without breaking the illusion of the proscenium frame by illuminating that as well?

Another problem with three-quarter front-light is how to continue it further upstage. On a proscenium stage, the header, which comprises the top part of the proscenium frame, gets in the way of using three-quarter front-light positions from many gallery box booms further upstage. Even when the header is not in the way, the angle becomes less steep the further upstage the light is focused, and so the 'spill pool' gets bigger and performer shadows get longer. If there is a back wall, or an upstage area that should be dark, this solution will not work. Finding positions for three-quarter front-light lanterns over stage can be difficult, especially so in theatres with a lot of flown scenery.

Breaking away from the three-quarter front system to light upstage areas can make matching the feel of the lighting upstage and downstage difficult, giving the impression that we have two different worlds onstage – one world downstage with a three-quarter front-light look, and another upstage with a different look.

One further problem with three-quarter front-light on relatively small performance spaces is the increased size across stage of the 'spill pool' compared with straight-in front-light. This can make it harder to define separate areas of the stage across its width, just as straight-in front-light can make it hard to separate upstage and downstage areas.

So for conventional front-lighting positions, there is rarely an ideal solution that successfully

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[6] American LD and professor Stanley McCandless codified this approach in his influential book *A Method of Lighting the Stage*, first published in 1932 and regularly reprinted for the next 30-plus years. Forty-five degrees is half a right angle, i.e. the same angle you get when you join the opposite corners of a square.

Figure 7 This student is focusing two three-quarter front-light profile fixtures near the proscenium. You can see the light 'spill' and her shadow on the proscenium wall to the right of the picture.

solves all the problems set by an evolving performance lighting design. Perhaps this explains the frequent use of follow-spots for larger-scale performances. The well-placed, well-operated follow-spot can be used to subtly 'lift' key faces out of steep area lighting. This is a common technique in opera and for live music concerts, where the primary role of the lighting is often to make a statement and to light the sometimes grandiose set.

In ballet, the primary role of the lighting is usually to emphasize the physicality of the dancers, while faces of chorus are less important, and here follow-spots are frequently used to highlight the principal dancers.

Light from below the performer's eye line

With the arrival of focusable electric light for the stage, most theatres threw out footlights for the 'unnatural' shadows they created and the barrier they made between performer and audience. However, many currently practising LDs have reintroduced light from the downstage edge of the stage, though usually in the form of small single units rather than the obtrusive 'floats'[7] of old. Light from this position has proved very useful. It can create unnatural shadows, which may be an intentional effect at times. It can also get light into the performers' eyes in otherwise difficult situations, such as when there are wide-brimmed hats being worn onstage, or when the available positions for front-light all result in steep angles.

Side- or cross-lighting emphasizes angularity, and is good for modelling the body. It helps the audience perception of depth. Cross-light can be used to create strong shadows on the body, emphasizing physicality, especially useful when lighting dance. To further emphasize the body, complementary colours can be used in the cross-light from each side of stage. Low-level cross-lighting is very often arranged to cast no shadow of the performer on the stage (the 'shin busters' mentioned above). For most classical ballet, the stage is arranged with wing flats, set to hide both the source of the cross-light (rigged on vertical pipes or towers called booms) and to contain the shadows of the performers. On an open performance area, the shadows from cross-light can become a distraction, especially with low side-light when the shadows are over life size, but the effect can also be used selectively to the advantage of the performance.

Perhaps more than any other genre of live performance, ballet, and to a lesser extent dance in general, has a set of rules concerning position and focus of lanterns. There is a requirement to produce light that shows the physicality of

[7] In the eighteenth and nineteenth centuries, floats was the name given to footlights consisting of wicks floating in a trough of oil. Later electric versions replaced the wicks with a row of incandescent lamps, similar to the ones in common domestic use in the twentieth century. Both types had a reflector cum glare guard perhaps 200mm high mounted behind the bulb or flame, which effectively cut off any view of performers' feet for much of the audience.

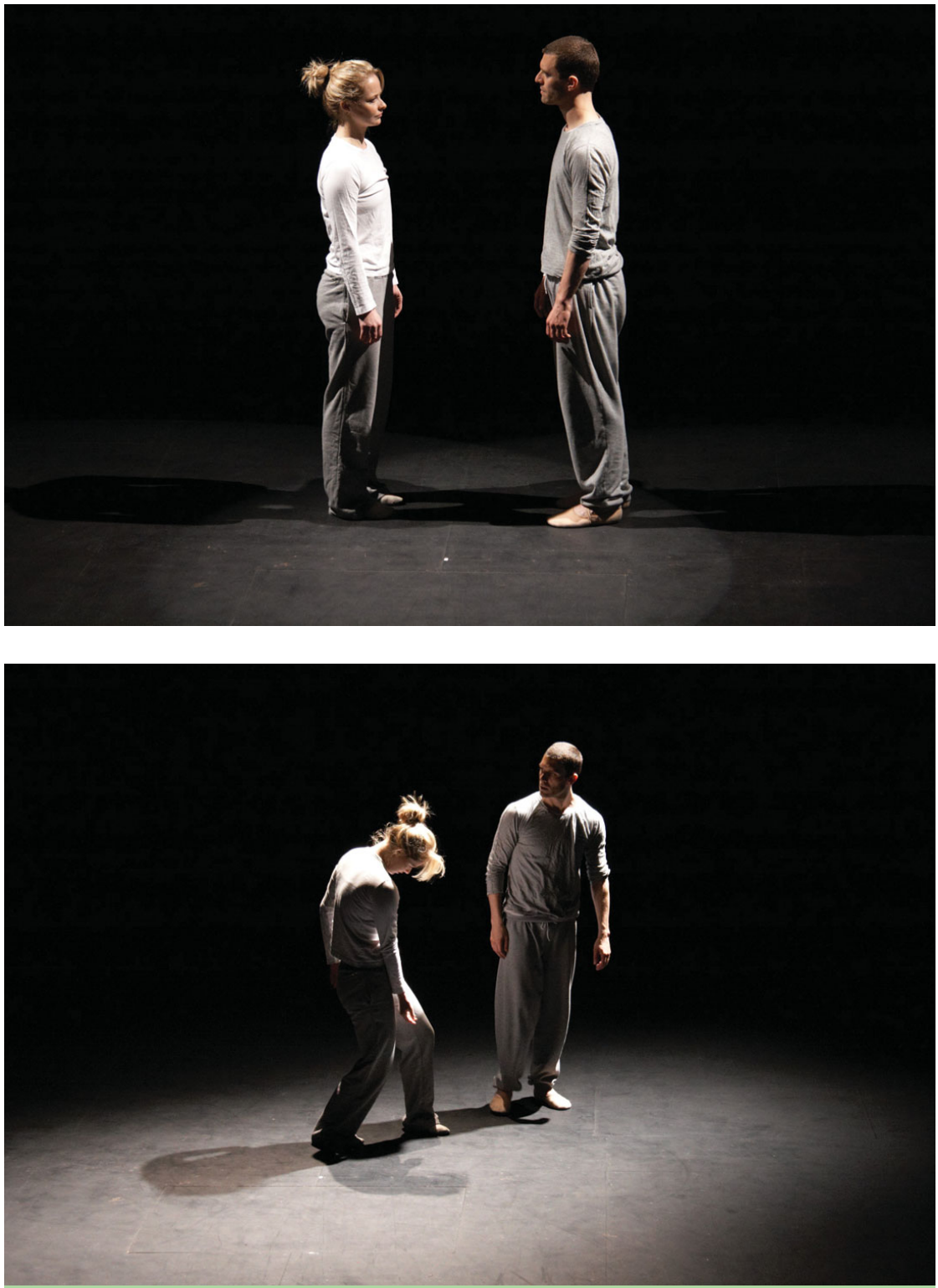

Figure 8 Two shots showing a pair of dancers, facing each other in cross light from both sides, and striking a pose in a pool of three-quarter back-light and top-light (from an Association of Lighting Designers master class given by Jennifer Tipton). Notice how faces and the contours of the dancers' bodies are rendered by the lighting in each image.

Figure 9 Often, to create the best look for a moment of performance we balance the intensity of the light from several directions, as in this picture. Can you guess how many sources are hitting each performer and how many angles of incidence are present? (From an ALD master class given by Jennifer Tipton.)

the dancers to best advantage over the whole stage, and to do this an arrangement of side- or cross-lights has developed and become almost universal. Anyone wishing to practise lighting for this genre needs to understand how and why this system works. The diagram in Figure 11 gives an idea of the focus, but as in other areas of performance lighting, there is no substitute for hands-on practice.

When wing flats are not available to mask booms and extraneous shadows, and sometimes even when they are, many designers use high cross-light to provide modelling, and sometimes to introduce coloured light. In music theatre, it is common to see pairs of lanterns rigged at the end of the lighting bar and pointing more or less across stage. These are referred to as pipe ends.[8] This position can be especially useful when there are a lot of bodies onstage, for example the large chorus of an opera or a musical, where light from lanterns rigged lower down on booms would be blocked by the first one or two performers on each side of stage.

Many prominent LDs make extensive use of cross-light in all kinds of theatre, not just in dance work. In confident hands, it becomes a tool to allow the LD to develop painterly scenes. Light from the side brings with it the possibility of

[8] 'Pipe' is the North American equivalent of bar or fly bar in the UK, and the name reflects the origin of this practice.

Figure 10 Dancers in head-height cross-light from booms.

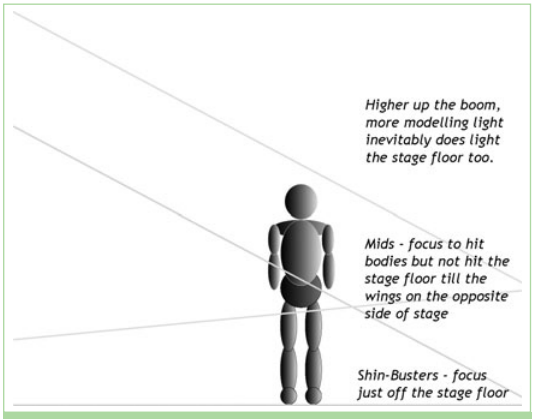
Higher up the boom, more modelling light inevitably does light the stage floor too.
Mids - focus to hit bodies but not hit the stage floor till the wings on the opposite side of stage
Shin-Busters - focus just off the stage floor

Figure 11 The focus of the lower units on a 'dance boom' helps to model the performer's body while keeping light off the stage floor.

producing an effect close to the chiaroscuro of Dutch and Italian Renaissance painting. The shadows are delicately filled with just enough light to provide an appropriate level of visual acuity, enabling the audience to see facial features. This kind of work cannot be accomplished without a significant level of cooperation between performer, director and LD.

Top-light or down-light

Top-light makes the figure seem more massive, creates very short shadows and can often seem to shorten the body. When the lanterns are too close to the performers, it can make the top of a performer's head the brightest part of the stage, which is not usually helpful. When there is enough height between performers and luminaires – say at least 8m – it is a good position from which to add colour to the stage, and especially to colour shadows on the stage floor. (Shadows are created when part of a beam is blocked and take on the colour of whatever light there is from other directions to fill the shadows.)

Top-light is frequently used to colour the stage floor, and can be used to add intensity to a scene without substantially changing the balance of face-light, but again this effect needs to be used with care. If some of the audience cannot see the stage floor the effect could be substantially different for them.[9]

Tight pools of top-light are often used as specials since light from directly above the performer minimizes the spill required to create an area of useful illumination (see Figure 9 in Chapter 2). In smaller performance spaces, it is sometimes only necessary to have the performer look slightly up to provide sufficient illumination for visual acuity. Sometimes it is possible to cheat, and rig the special unit slightly downstage of the performer's position of stage, or use the performer's costume to 'bounce' light into their eyes. Sometimes we can use the light reflected from the floor to fill the

[9] Such differences in audience experience for different sections of the audience are not limited to the use of top-light, or even to lighting effects. Conscientious members of the creative team will usually try to see the performance from as many different audience locations as possible to discover such differences.

Figure 12 Lighting student Libby is seen here in the same top-light special in both the above shots. In the first shot, the features of her face are hidden in shadow. In the second shot, on the right, light is bounced off white paper to reveal her eyes.

shadows just enough. More often, if it is appropriate to see the face, a low-intensity, secondary source will be needed, and this could perhaps come from a footlight or side-light position.

Top-light is of limited use in concert lighting for pop and rock bands in sports arenas or open-air festivals. Most of the audience cannot see the floor, and the structural effect of beams is less pronounced with top-light than with back-light. For classical concerts, however, top-light can be used to illuminate the music and the instruments with the minimum of glare and extraneous shadow, good for both the players and the audience.

Back-light

Light from the side of a performer or from immediately above a performer has some impact on the audience's ability to see the facial features of the performer. Light from behind the body of a performer facing the audience clearly does nothing to illuminate that performer's face, so why is it considered so important by almost all performance LDs? What back-light does for performance lighting design is to further emphasize the three-dimensional physicality of both the performers and the performance space. Back-light, by illuminating the edges of performers and objects, especially curved objects with 'fuzzy' edges (such as the head of a performer?), helps the spectator to perceive depth in the individual objects and separation between subject and background.

Human stereoscopic vision only works over a relatively short distance. In large spaces, we need help to work out the relative distance to the various objects in our field of view. Because of this, back-light is an important tool for the performance LD, especially in large performance spaces, such as the sports arenas and festival sites where rock and pop acts perform. Live-concert lighting rigs are often dominated by back-light sources.

Just back-light on a performer can help to produce very dramatic effects, perhaps because

the presence of the body is emphasized without giving the audience sight of the face – there can be no direct reading of the face so suggestion can be used to full effect. Concert lighting, especially for rock music, makes huge use of these effects, concentrating attention on shapes onstage rather than details.

Whenever there is dust or smoke in the air above stage, back-light reveals itself, an effect more concerned with throw than angle of incidence, but important nonetheless.

Standard video and film cameras, having only one 'eye', have no stereoscopic vision, and often back-light provides the only visual cue separating performer from background.

Face-light

It is important to distinguish between front-light and face-light. In a traditional proscenium theatre front-light is light from a particular direction or set of directions – generally from positions in the auditorium, above the heads of the audience. Face-light is any light that gets into the faces of the performers. This could be front-light if the performers are directly facing the audience, playing 'out' as it is sometimes called. A lot of drama (and other performance) is played across the stage, however. For example, two actors in dialogue tend to look across the stage at each other rather than directly out at the audience. As lighting designer Rick Fisher has said, lighting the face is very different from lighting the whole head. The face is less than a quarter of the head. As often as not, face-light for drama (and often opera) comes at least as much from the sides of the stage as it does from the auditorium.

The lighting design for *Dilemma of a Ghost* was conceived without conventional front-light,

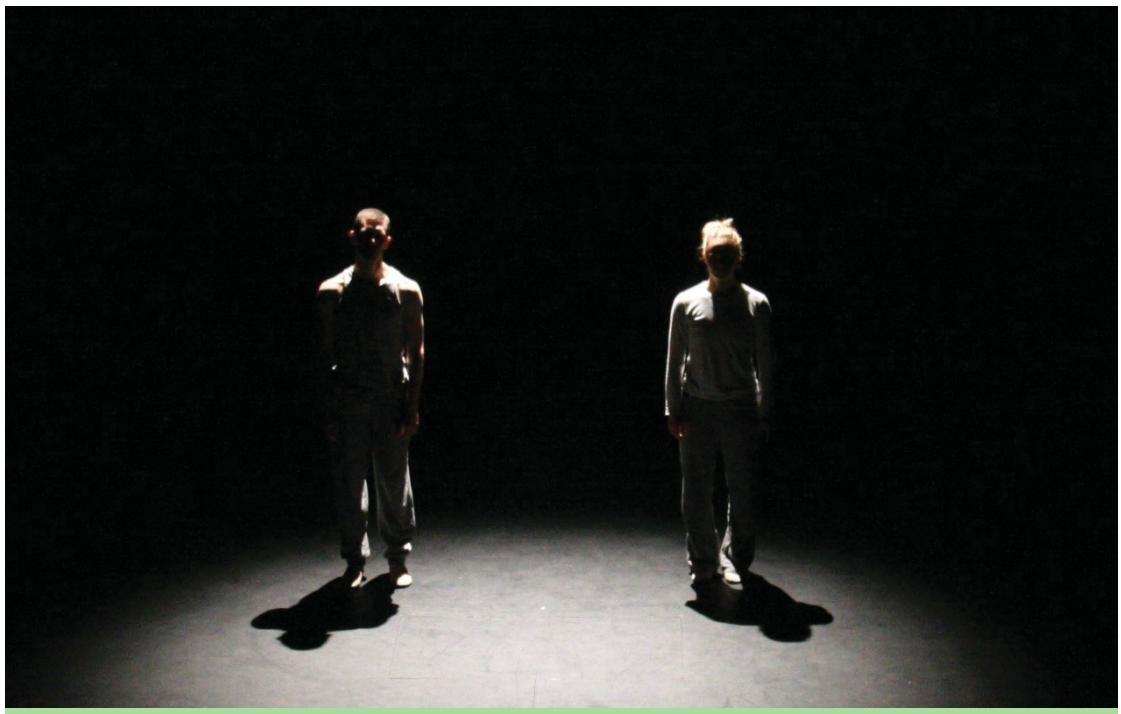

Figure 13 Two dancers lit only in back-light.

for a number of reasons. The faces in the image at the beginning of this chapter are lit primarily from positions around 30 degrees above the horizontal and from the sides of the stage. In Figure 14, the older woman (the mother-in-law of the man, on a visit) is lit mostly from what amounts to a three-quarter back-light position.

Using angle of incidence

Angles of incidence can be used to help enhance mood and atmosphere. For example, shadows produced by light from 'unnatural' directions not normally found in nature draw attention to themselves and can signify the supernatural or dreams. The long shadows cast by lanterns at or below performer eye line can be very atmospheric, as can strong back-lighting. A strong single source, such as the large discharge Fresnels favoured by many opera LDs, can create massive scenographic statements almost on their own, and getting these units in just the right place can be the key to success in this type of design work.

Changes in angle, causing changes in where shadows fall and in shadow length, can help to signify changes in time of day or season. The light of dawn and sunset comes from close to the horizon and produces long shadows, while the light of midday produces short shadows. The problem here is that very often urban dwellers

Figure 14 Another image from *Dilemma of a Ghost*, a show lit with no conventional 'front-light'. Instead, face-light for the younger woman and the man is coming from over the downstage shoulders of the older woman, while most of the light on her face is from the three-quarter back-light key, behind and above the man.

don't notice these things, so the sign may not be widely read by the audience.

The throw

A performance lighting rig usually needs to work with the aesthetic of both the production and the space. Visible beams can draw attention to the source of illumination (and potentially away from the performance on the stage). While a massive lighting system can become a dominant element of the design, especially when it comes to concert lighting, some productions ask the audience to willingly suspend their disbelief in the 'staged' nature of the piece and the sight of lighting instruments and the beams they produce could be at odds with this aesthetic.

One of the key design decisions in most theatre work on a proscenium stage is: will the lanterns be visible either above the stage or elsewhere, or will they be masked, for example by flown borders? Either decision presents the LD with possibilities and problems regarding placement of lanterns; that is the choice of 'throw'. Usually the audience accept that they are watching a staged performance, and that means they will see some lighting equipment and other technical material around the performance area. Often we will not want the presence of the technical equipment to be distracting, or for there to be sources of glare from unmasked lanterns.

There are other factors to be considered in decisions relating to throw. A strong beam, apparently from an unseen source far away in the heavens, has been a signifier of the presence of a deity in Western art since pre-Renaissance times; clouds part, revealing the 'hand of God'. But was that what the LD wanted the audience to read into their use of a big back-light? Perhaps less dramatically, we might want to evoke a confined interior on an open stage. If the audience can see beams from distant lanterns in dust or haze above the stage, even just sources high above the performers, will they buy into the scene as confined interior?

Visible beams of light can have an architectural presence onstage. Stage designer Josef Svoboda, working in Prague in the last century, created curtains of light. The beams were made more visible by filling the air with tiny droplets of moisture, creating vast three-dimensional shapes in space, which could appear and disappear with the push of a fader. Architectural effects such as this have been used with great effect to signify abstract notions such as the isolation of a single performer or the grandeur of the gods. Visible beams of light can be used to signify physical structures, and they are the stock in trade of concert LDs, used to modify the audience's perceptions of the size and nature of the performance space.

Such use of light draws attention to itself, foregrounding the language of stage lighting, potentially distracting the audience from the main action onstage. Conversely, strong architectural lighting can evoke place or atmosphere, aiding the production. As with any potentially dominant theatrical sign, the use of strong architectural lighting has to be thought out and fully integrated into the language of signs within the production.

Much of the time where the lantern hangs in relation to the stage is defined by what it has to illuminate, how the target will be illuminated and the physical constraints of the space. Large numbers of very visible lanterns in the auditorium or over the stage, say something to the audience members about where they are and what sort of experience they may be in for. It seems clear that the decision to hide or show the lighting will have an impact on the audience's expectations of the production. In the semiotics of the French

Figure 15 An image from *The Wedding Party* (Royal Central School of Speech and Drama). A 'curtain' of light has an architectural effect, creating something almost solid in the smoky air – but also creating a bright pool on the stage. The lighting designer will need to balance the two effects.

philosopher Roland Barthes, it will alter the decoding grid used by an audience.[10] It should therefore be a matter for the whole of the production team, not just the LD. Having said that, often the only way to illuminate a particular element of a production is to use lanterns that show their presence to the audience, and the LD must be prepared to argue that the ends justify the means (providing that they do!).

Colour

A conventional rig usually uses thin sheets of coloured film in front of the lantern to colour the beam. We talk about 'adding' colour to the light, but in fact we know we are taking some colours out of the white light, leaving behind the colour we want. These thin sheets are still referred to as 'gels', harking back to the original coloured

[10] Barthes introduced the idea of a decoding grid to semiotic discussions in 1970 with his book *S/Z*. His original ideas have been considerably elaborated upon since then both by himself and others. In essence, the decoding grid is the assumptions and other information we as audience use to make sense of what we see, hear, feel, etc. In this case, someone who regularly attends a range of performance genre would assume a different style of presentation from an open stage with the lighting rig in plain sight and from a naturalistic interior setting with full masking.

Figure 16 Lighting colour swatch books.

'gelatine', though these days we use plastics of various kinds. The major manufacturers of lighting filters produce swatch books of their colours for reference, some of which include graphics for each colour in the range, indicating the proportion of light filtered at each wavelength. It is relatively easy to get hold of these sample swatch books at trade fairs or from the sales counter of any decent lighting hire company.

All lighting filters reduce the intensity of the lanterns that they are used in to some extent, and using deep colour in lighting filters can dramatically reduce the amount of light reaching the stage. Strongly coloured gels tend to absorb a lot of infrared (heat) from the light source, which makes the filter more prone to fading, and in some cases melting, over time. To some extent, this problem can be overcome by using specially dyed glass filters, which last much longer than plastic filters. However, glass is more fragile and the initial costs are much greater, as is the cost of the LD changing their mind about the colour they want.[11]

Dichroic filters, as used in most moving light, usually consist of heat-proof glass coated with very thin layers of material. They allow some light frequencies to pass through (just as in a plastic filter) but rather than absorb the rest, the other frequencies of light are reflected. A red dichroic filter may look green on the surface, and does not look red unless you look through it. The band of frequencies passed by a dichroic filter can be precisely controlled in the manufacturing process. This can result in much more a-chromatic light – light of just a very few frequencies – an effect which is impossible to achieve with dyed plastic or glass filters, hence the potential for a different quality of light with dichroic filtering.

Human response to colour

Our perception of colour is subjective. What we have just seen, and what we see alongside a particular thing, has an effect on the colour we perceive that thing to be. When talking about light and colour onstage it is also worth remembering that we cannot distinguish between a neutrally coloured object illuminated with

[11] The subtractive way in which colour filters work can lead to some perhaps unexpected results, for example when using two sheets of the same colour in a single gel frame. If the chosen filter removes 20 per cent of all blue light present, the first sheet leaves 80 per cent of all the blue light in the beam. The second sheet removes a further 20 per cent of what is left, not of what you started with, so adding a second sheet of filter usually has a smaller effect than you might suppose on increasing the depth of the colour on stage while often removing more useful light thus reducing intensity. It is usually better to choose a single colour rather than double up filters.

coloured light and a coloured object illuminated with neutral light.

Our emotional and intellectual response to colour is largely learned and therefore culturally specific. We may respond well to colours we associate with pleasant early experiences. These responses will be unique to the individual and therefore unavailable to performance practitioners wanting to communicate to a whole audience. However, scientific work has been done to show that some responses to colour are more general in the population. Here are some examples:

- Heart rate tends to speed up in response to the colour red, and slow down in response to the colour blue.
- Advertisers have found that yellow is often associated with fun, red with passion, and blues and greens with calm and security.
- Purple is often associated with dignity, for example the regal purple of ancient Rome and the medieval era in Europe.
- In the West, black, brown and grey are associated with sadness and black is the colour of mourning. In some Eastern cultures white is the mourning colour.
- Most people associate the adjective 'warm' with colours near the red end of the spectrum, including orange and some yellows, and 'cool' with the blue end of the spectrum, but . . .

Warm and cool

These two terms are frequently used to describe light in performance, the atmosphere and mood as well as the colour. It is as well to be sure everyone understands the same things by these words before basing a discussion around them. Here is what I mean by warm and cool:

Warm: as in the comforting light of a domestic fire, the glow of a sunset in fine weather, the atmosphere between contented lovers or among a happy family or group of friends. In performance lighting terms I mean soft shadows, orange, red and yellow tints, perhaps relying on incandescent sources at lower intensity to increase the proportion of red light in the 'white'. All skin tones glow and look healthy.

Cool: as in the light of a clear bright winter day, the light of clinical or scientific spaces, the atmosphere between recently separated lovers, or among a family split by arguments. In performance lighting terms: harsh and revealing, lots of pale-blue tints and no hints of reds or orange, perhaps making use of fluorescent and white discharge sources, or incandescent lamps at full. Shadows where they are present are hard edged. Pale skin tones look starved of blood. All skin tones begin to look lifeless, but this light can animate the facial features with its harder shadows.

If we are to use these notions as signifiers in a lighting design, everybody concerned has to be using the words in more or less the same ways. It is worth thinking about what your version is, and what others you are working with understand by these terms.

Red and blue and focus

Our eyes have a single lens. In Chapter 1, we saw that different wavelengths of light bend by different amounts in lens or a prism. This is behind the formation of a rainbow. For our eyes, the physics means we cannot focus both red and blue light from the same distance at the same time. In technical terms, there is a difference in the focal length of red and blue light for a simple lens system. This shows up in some moving light

applications. For example a gobo focused sharp in blue may look soft in red, requiring a lens adjustment between the two colours if sharpness is required for both.

This effect is what can make the stage of a rock concert, bathed in pure deep-blue light from moving lights with dichroic filters, seem slightly fussy and out of focus when we are looking at the solo artist in a follow-spot. It is quite fun to play with the effect and with a bit of planning can be used in other places than the rock stage. To get the full effect, the saturated background light has to be close to one end or the other of the visible spectrum (blue seems to work best) and other frequencies of light (i.e. other colours of light) have to be removed – dichroic filters do this better than gels. Then you need a strong central image to focus audience attention, lit to provide good visual acuity.

Colour theories and complementary colours

The colour of light can be described in a number of ways. We have seen that the different colours of the spectrum have different wavelengths. However, coloured light is usually composed of a mix of wavelengths. It is possible to define a colour of light by the relative intensity of each wavelength present, as some filter manufacturers do in their swatch books.

Another way of describing a colour is the CIE colour model. Developed in France by the Commission International de L'Eclairage (CIE), in the first half of the last century, this model relates more directly to the way our eyes work. It uses three terms to describe colour: hue, saturation and value. The system was designed to describe the colour of pigments rather than the colour of light, with value representing the relative lightness or darkness of a pigment. In light terms value can be replaced by intensity. Hue is closest to what we ordinarily call colour: red, blue, green, yellow, magenta, cyan, orange, purple, turquoise, and so on. In this system, six colours are called the primary and secondary

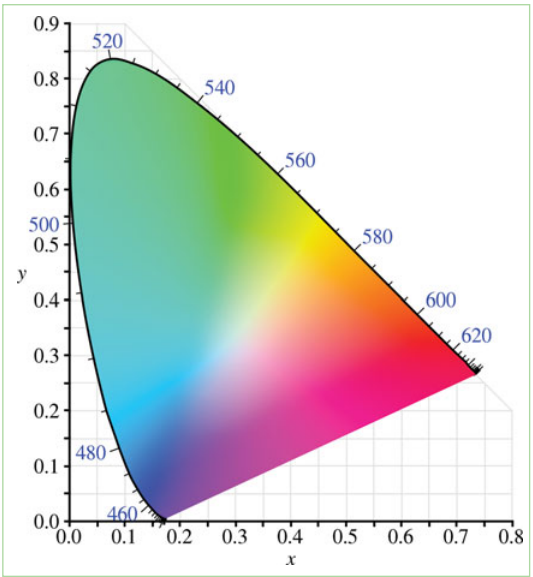

Figure 17 The CIE colour model, representing all the colours visible to the average human eye. At the curved horseshoe edge of the diagram are the spectral colours at maximum saturation, single wavelength of light (the numbers in blue are the wavelength). Light of these colours is also called monochromatic. Other colours are made by mixing proportions of monochromatic light – i.e. by mixing selected wavelengths. All the colours on a straight line between any two points can be made by mixing proportions of the colours at the two end points (in theory).

Along the bottom is the line of purples. These are not monochromatic colours, but a mix of different proportions of red and blue light.

Near the intersection of 0.3x and 0.3y is the achromatic white point – white light as a mix of all the visible wavelengths. This is also the point of zero saturation. So for any given hue, saturation increases to a maximum in a straight line from the 'white' centre towards an edge.

Colour temperature is sometimes drawn as a curve passing through the achromatic point, heading towards blue as the colour temperature increases and red as the colour temperature decreases.

Figure 18 Lighting student Jenny lit from her left by 'warm light' and from her right by 'cool light'. Complementary colours filling the shadows make them more evident than if she were lit with the same colour from both sides. This helps to make her face appear more three-dimensional.

colours: for light, red–green–blue are the primary colours, and cyan–magenta–yellow are the secondary colours. Saturation is a measure of how much hue is present. In Figure 17, fully saturated red is in the bottom right corner as you look at the page. Imagine a straight line from this point to the white point at the heart of the shape. Along this line saturation gradually decreases while the hue remains constant. At the white centre, known as the achromatic point, the saturation is zero, whatever the hue.

So how does this relate to the practice of performance lighting? Many moving lights are able to 'mix' colour, using a variety of systems. In theory these units can produce any colour of light from the two-dimensional CIE diagram. In practice there are a number of limiting factors, including the colour temperature and colour rendering index of the light source, and the pre-cision with which the filters are manufactured. Many moving light consoles are now offering practitioners the opportunity to pick and adjust the colours they use with controls for hue and saturation. The hue control selects the base colour and saturation control the depth of that colour.

Warm from one side, cool from the other

It is common practice in theatre lighting to fill the shadows created by the main light sources with less dominant sources in a complementary colour, but what are complementary colours in light? For most performance lighting practitioners, complementary colours of light are those that, when added together, make something close to white light. The complementary for any colour of light should be on a straight line through the white achromatic point of the CIE colour diagram (Figure 17). However, our visual perception does not function quite like that, and the best results are obtained by experiment.

For the practice of lighting performers from either side in different colours, we are usually looking for complementary tints that don't look too unnatural on their own. These pairs will be found near the achromatic point on the CIE diagram. This technique enables fuller illumination of the subjects, without losing too much of the definition-created shadows.

Colour and back-light

Back-light is often more strongly coloured than front-light and this can 'lift' the performers away from the settings, providing a degree of colour contrast. Because back-light does not generally fall on the faces of performers, there is less chance of disturbing the audience with 'unnatural' colours. (This stops being the case as soon as the audience is on more than one side, however. As we have already noted, for theatre in the round the back-light of one audience is the

front-light of another.) As we have said, back-light illuminates the fringes of people and objects, so if it has a strong colour, objects can appear fringed in that colour. We are used to seeing the blue of the sky as a background to our world, and perhaps this is why audiences appear to accept blue back-light so easily. Whatever the reason, blue back-light is almost ubiquitous in Western performance lighting.

Colour as a signifier: helping to tell a story

Colour signifiers are often presented in pairs, and this makes sense when we think about the way we perceive each colour in comparison to the other colours around at the moment of perception and in the immediate past rather than absolutely. We have to have some other colour to compare each newly perceived colour with. There appears to be no colour equivalent to perfect pitch, where some individuals can hear a musical note and immediately place it accurately on a scale. This fact has some fundamental implications for the performance lighting practitioner. Here are just three things to consider:

Looking at lighting states out of sequence can give a false impression of what the audience will perceive. (This is true for intensity too.)

Some tints, such as pale lavenders, can be made to seem warm or cool depending on what other colours are dominant at the time.

Large areas of strong colour, for example from the set, or even more so from a brightly lit cyclorama, will have a significant influence on the audience's perception of other colours.

Using complementary tints from each side of stage and more strongly coloured back-light is primarily a functional sign. It is a technique that helps the audience to see better without really being conscious of how much visual acuity would be lost without its use. This is not to say that the use of tints from the sides, or stronger colour from the back-light, cannot be used to indicate other things; the cooler light of winter against the warmer light of summer, the yellow tint of candle light against the white of sunlight, the 'natural-ness' of blue back-light against the 'magical-ness' of, say, purple back-light. All of these can be employed as signifiers of time and place and mood, along with aiding visual acuity.

For many traditions of performance lighting, colour provides only subliminal cues, aiding audience perception of space when used in conjunction with other variables. Important for the variation and depth that it helps to add to the stage picture, the use of strong colour can be problematic due to the subjectivity of audience response and the perceived anti-naturalism it evokes. Generally, we do not see strongly coloured light in nature, so when we do see it, we can become aware of both the light (which most people hardly ever notice except when it is not 'natural') and its colour. As with other ways in which light in performance makes its presence directly felt, strongly coloured light needs to be handled with care.

Colour fatigue and colour adaptation

Colour fatigue leads to the apparent 'dilution' of strong colour over time – as little as a minute – even when no actual change in the colour occurs. It is as if our eyes get tired of looking at a strong colour and it stops registering as much – a bit like the way the noise of a fan or traffic can disappear into the background after a short while. It is particularly noticeable when there is a single area of strong deep colour filling a large part of the

visual field. Several conceptual artists have used this effect. For example, Dan Flavin[12] and Olafur Eliasson[13] have both used arrays of discharge lamps whose colour actually remains constant, yet appears to the observers to change over time.

Colour adaptation is where our perception 're-sets the white balance' of the eye to help to make sense of the world. This happens when we wear coloured sunglasses. Very quickly, we perceive faces and other objects we know well, to look a natural colour. If you take a photograph through (non-prescription) coloured sunglasses, you will see how distorted the colours really are, but your brain 'refuses to be fooled' by tinted glasses. This effect sometimes only becomes obvious when we see photographs of lighting design. Something that looked quite naturally lit to us as audience in a photograph is revealed to be much more coloured.

Both effects can be used to advantage or can get in the way of what you are trying to do as an LD.

Beam and movement

Glory be to God for dappled things
(Gerard Manley Hopkins, 'Pied Beauty')

Long before the birth of modern moving lights, Adolph Appia[14] was trying to persuade the great opera composer Richard Wagner that dappled light could be a more powerful sign of 'forest' than any number of painted trees on stage. Since then this notion has been enthusiastically taken up by LDs working in many genre of performance. Gobos[15] can add texture to light. They are usually etched in metal or onto glass, and placed in the 'gate' of a conventional profile lantern or suitable moving light. The image on the gobo is then projected in the beam of the lantern.

Figure 19 Three gobos, two showing signs of just how hot the gate of a tungsten halogen profile lantern gets.

The gobo has become a prominent signifier in much of British and American performance lighting. 'Hard focused' and thus clear and distinct, or 'soft' and impressionistic, these patterns

[12] Flavin has used fluorescent and other cold cathode lamps (for example neon lights) to create art works that although unchanging appear to the observer to change over time.
[13] The weather project installed at the Tate Modern in London, England in 2003/4 had a large sun, powered by low-pressure sodium lamps of the kind used in older street lighting. They emit a very narrow band of yellow light, unvarying in its colour. Despite this most observers perceived the colour of Eliason's sun to change over time, due in part to the effect of colour fatigue.
[14] Adolph Appia (1862–1928) worked with Wagner at the composer's theatre in Bayreuth. He argued that the scenographer should create a three-dimensional world for the performers to inhabit rather than a set of two-dimensional painted cloths for the performer to stand in front of. Along with Gordon Craig (1872–1966), Appia is frequently cited as the one of the fathers of modern scenography.
[15] Gobos are referred to as templates in North American practice.

projected in light have been used in many different ways: to 'paint' New York fire escapes onto a plain brick wall, to depict flashing neon signs, to signify the sun shining through a tall window (all iconic signs), or provide the gently moving dappled light signifying a forest (perhaps a more complex sign, iconic of light in a forest, index of 'hidden' trees and often symbol of something else – fruitless searching or pastoral tranquillity perhaps).

There are ways to 'animate' the image projected from the gobo, so we can create the gently rippling light through trees dreamed of by Appia, or imitate light reflected from a canal, without any water onstage.

Many moving lights have multiple gobos, often able to rotate, and often on two or more wheels, so that patterns can appear to dissolve, or morph, from one image to another. Some moving lights incorporate an animation wheel.

Shutters

Shutters, the beam-shaping blades of conventional profile luminaires, are now also available in some moving lights. The ability to remotely and dynamically shape a box of light onstage is exciting. Accurate remotely controlled shuttering allows the possibility of creating and manipulating spaces on a stage with much more fluidity than is possible with conventional flown or trucked scenery. It offers a new dynamic on the performance stage, potentially more powerful than anything moving lights have brought us so far. The round edge of a beam onstage remains just that – the edge of a beam. A sharply defined square or rectangular beam, however, can signify the edges of a real or imagined space – and when those edges can move, more possibilities present themselves. The potential is exciting, whether remotely controlled shutters are used to compensate for last-minute changes to blocking, or they are used to dynamically manipulate the audience's perception of space.

Quality

Beam quality is used with at least two different meanings in performance lighting. The first we have already touched on and refers more to the colour composition of the beam, how much of each frequency of light is present. We talk about the quality of light from an incandescent lamp being different to that from a discharge lamp, and by that we usually mean that the balance of light frequencies in each beam is different. We have already encountered colour temperature and CRI to at least partly describe this aspect of the quality of the beam.

The second meaning refers to the pattern of intensity across the beam of a luminaire, how the intensity falls off towards the edge of the beam, and the crispness of the shadows produced by that luminaire. This gives us words to describe the difference between the light from for example, a Fresnel luminaire with a 'peaky' beam and a 'soft' edge, and a profile luminaire with a 'flat' beam and a 'hard' edge. Or the differences in the shadow produced by light from a unit with a lens (which generally will produce a crisp shadow), a soft light (which often produces very little discernible shadow) and an LED fixture (which may produce – potentially distracting – multiple shadows).

Beam quality also refers to the difference in edge quality of a profile 'focused' in different ways – with a hard edge or a soft edge for example. In this context, we use the words 'focus it' to mean how the lens or lenses of the profile lantern are adjusted, as opposed to how the light hits the stage and objects on it (angle of

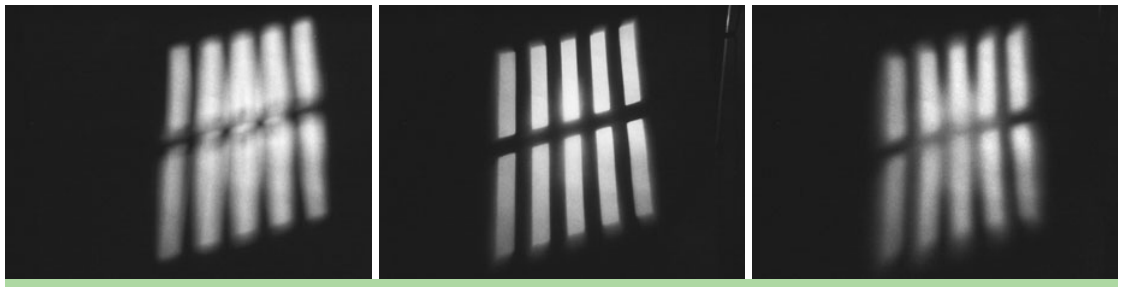

Figure 20 Three views of the beam of a profile lantern with a gobo, showing two different versions of a 'soft' beam – soft brown and soft blue, either side of a 'sharp' beam.

incidence) or the path the light takes to the stage (throw).[16]

Soft and hard edges are important in performance lighting. Soft-edged beams are easier to blend into one another. We are more sensitive to the sharp changes in intensity that occur at the edge of a hard-edged beam, which can make them more difficult to blend into a wash. Most performance lighting will make use of both; for example, the soft edges for lanterns used in a wash and the hard edges for those used as specials. Soft-edged beams can lead to 'spill' or 'flare', unintended light causing distractions.

Describing performance light: a summary

Once again we have covered a lot of ground in this chapter, about the mechanics of lanterns and lantern placement, a little of the history of performance lighting, some useful stuff on human visual perception – what we might call the psycho-physics of human perception, and the beginnings of how choices of lantern and position have an impact on the images we produce onstage. Here are some points to carry with you into the following chapters:

- It is useful to consider performance light in terms of four interrelated properties – intensity, focus, colour and beam – but to remember also that time as a variable has an impact on everything we do.
- The mechanics and biology of human visual perception are just as important as the physics of light and light production.
- Humans are able to concentrate on detail in a relatively small area of our visual field – we can watch the show from the back of a large theatre or stadium, even though the action only occupies a small proportion of what we can see.
- It helps if the rest of the visual field is dark – so dim those house lights, especially in large auditoriums.
- We are distracted by small areas of light, and especially movement, at the edge of the visual field – keep an eye out for flickers from faulty emergency lighting and extraneous light spilling from the lighting fixtures.

[16] Unfortunately, this multiple use of the word focus is widespread in performance lighting practice, among English speakers and beyond. Context will usually define which meaning is intended, but there will be occasions when it becomes necessary to distinguish between 'focus the unit', meaning change its pan and tilt, and 'focus the unit', meaning adjust the relative position of lenses and other optical elements.

- Human eyes can make more use of both lower and higher intensities than many cameras, but there are limits. We are not great at dealing with both very low and very high intensity at the same time (but we are better than most cameras are at this).
- Humans don't perceive absolute intensity. A candle flame that is bright in a windowless cellar is barely visible outside in daylight. Perceived intensity depends on what went before. A black-out is usually only relative. If the audience has become accustomed to a bright state onstage, they will perceive as 'blacked out' a stage with enough light for a scene change.
- We don't have an absolute reference for colour. For example, lavender light can appear warm in comparison to blue tints and cool in comparison to amber tints.
- Adding colours together in light tends towards white. Overlapping the beams of three lanterns, each with a different primary colour filter (red, green and blue), will result in white light (providing the intensity of each beam is matched). Putting all three filters in the same lantern will result in little or no light coming out, however!
- One way of describing complementary colours in light is to say they add up to something close to white. This is useful when it comes to combining light from two sides of a performance space to achieve a 'natural' colour while enhancing three-dimensionality through coloured shadow.
- Dimming the intensity of an incandescent lamp changes the colour of the light it emits. Lower intensities have proportionally more red light – they look 'warmer'. At or near full power, not only is there more intensity, there is proportionally more blue in the light – and the light looks 'cooler'.
- Filtering white light with glass or plastic lighting filters or dichroic filters reduces the intensity of light reaching the stage.
- The closer a luminaire is to the stage, the brighter its beam onstage. Generally, if you halve the distance between stage and luminaire you get four times the intensity. (This is called the inverse square law.)
- Our eyes have a different sensitivity to different colours, so a particular intensity of yellow light will seem brighter than the same intensity of blue light.
- Almost any change we make to the beam of a luminaire will affect its intensity; that is the amount of usable light that hits the stage and the people and objects on it including introducing a gobo or changing the edge quality (focusing the lenses).

As we saw in the last chapter, what we are used to seeing we perceive as natural – and generally don't consciously notice. Things we perceive as unnatural can draw attention to themselves. Performance lighting can make use of this, and can be tripped up by it too. When the lighting for a performance creates shadows that are too different from those the audience perceive as natural, when the colours used are too far from those seen in nature, the audience will begin to read the lighting. If that is the intention, then all is well. If it is not, then the lighting practitioners on the production may be in trouble. As always, anyone concerned with performance lighting must take care to ensure that what is read by the audience is in harmony with what is intended by the whole creative team working on the production.

Figure 21 Try to be as aware as you can be of the ways in which light has an effect on how the world appears to us. For example in this image, notice the way the sunlight casts shadows and how light from the blue sky fills some of these shadows.

4

From text to lighting concept

Stage 1: what is a text?

Most works of performance begin their life with a text. A group of people, the production team, assemble with some ideas about something they want to put in front of an audience. In theatre, the text is most often a piece of writing, either words alone or words and music. The text may be new writing or it may be a re-presentation of a pre-existing work. The intention may be to base the performance closely on the text, or it may be to use the original writing as a jumping-off point for a devised performance, or something in between. For many live concerts, the spur for performance may be recorded music – a band's demo recording or new album. This may be augmented by the band's vision for their music, or by a commercial marketing strategy. For a dance performance too the initial inspiration is often a musical score, but it may also be a response to poetry or prose, to a painting or another work of art, or a particular event. We can think of making performance as a way of getting something extra out of these texts; something that the audience would not 'get' from experiencing the original text alone.[1]

Creating the world of the performance

What design for the performance space does is to create a world for the performers to inhabit. That world may be an outlandish fantasy of the immense stages designed for the stadium rock shows of The Rolling Stones,[2] or may be an evocation of part-real and part-imagined spaces such as those seen on many opera stages, or the multiple elements of the stage sets of many spectacular musicals, or the relatively bare and open space 'pregnant with possibilities' of many dance works. Of course the world of the performance may be many other things. The one thing it is not is the 'everyday world'. Perhaps the best way to illustrate this is to look at performance in non-theatre spaces – where the space of performance is the *found space* of environmental theatre or site-specific work. This kind of performance takes place in cellars, in disused buildings, in open country and other surprising places. Simply by becoming a performance space, we, as audience, are asked to see it differently. Several companies who make environmental theatre have used empty department stores, for example.

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[1] Once it exists, the performance itself in turn becomes a 'text' too.
[2] Sets by Mark Fisher, lighting by Patrick Woodroffe.

The randomly half-dismantled display stands and abandoned artefacts left behind in a closed-down department store were just incidental yesterday. In the moment of performance they become potential signifiers, triggering memories or colouring the audience response to other aspects of the performance, capable of telling their stories about past uses and past users of the building. The incidental becomes potentially significant: a set of pegs with the names of past employees may conjure up, in the imagination of the audience, ghost images of those people at work. An abandoned cutting table, with a brass measuring edge marked off in feet and inches, reminds older audience members of a past before metric measurement. A blueprint of the developer's plans for the old store's future, left on the floor by someone, can take the audience's imagination somewhere new. By taking on the role of audience, we are made to look harder, to see a kind of beauty in the pattern left by years of dust rising from a radiator, or tragedy in a once-fine ceiling rotted by years of neglect. We invest in the performance and in the evocation of its world. If this is true in an abandoned shop, where the 'set' is largely unpremeditated by the production team,[3] how much more true should it be on a performance stage?

When it works well, performance turns us from casual observers into active audience, exercising our human instinct to 'make sense' of the world, and this places a responsibility on everyone concerned with everything that is seen and heard on a stage. Set design may be the beginning of that signification process; every object choice, every colour choice, every choice about the shape of the space is potentially able to either reinforce or undermine the creation of that world of performance. For the LD too, each shaft and each wash of light is capable of influencing the audience's reading of the world created for that performance, by what light reveals, half-reveals and hides, by the way it reveals and for itself.

In almost all work for live performance, the performers inhabit this world of the performance. Along with practical considerations, usually including the provision of entrances and exits, and ensuring they can be seen by their audience, performance design is there to support the performers communication with the audience.

Jerzy Grotowski, the influential Polish director,[4] placed the relationship between actor and audience at the centre of his 'poor theatre'. His practice pared away set, props, structured lighting and artificial sound, and even the separate performance area, to concentrate on the audience's intimate experience of the actor. This relationship between performer and audience is at the centre of almost all successful performance, and though the 'poor theatre' aesthetic is not appropriate to every style of production, a designer working on the creation of a performance should question any aspect of the design that gets in the way of this communication.

What can light do?

A child is working on a drawing, talking about what she is doing and why as she is drawing lines and choosing colours.[5] A second child looks over

[3] The environment of environmental theatre is never entirely accidental. Choices have been made; first about the space itself, and then about which parts of the space the audience will see, and in what order, and how they will be illuminated. Very often, especially in abandoned buildings, a lot of work is done both to make the space safe, and to present it in a particular way. Lighting projects like these are among the most challenging and rewarding of roles available to a LD.

[4] Born 1933, died 1999.

[5] I am grateful to Flick Ansell and Alex Stone for this analogy.

her shoulder, watching what she is doing, listening to what she is saying and occasionally asking questions and making suggestions. At a certain moment, the first child hands the drawing to the second one. At this point the second child can do one of two things – she can either scribble all over the drawing, obscuring the original intent and making a mess or she can add marks that complement the original, working with the colours and lines already on the paper. In case you have not already guessed, LDs often find themselves in the position of that second child. Light in performance is most often required to support the performance, to help tell the story, to add an extra dimension, to guide the focus and mood of the audience, occasionally to play directly on the emotions of the audience, but always in support of a wider objective. Making a good lighting design for a production requires the LD to work in sympathy with others, frequently working with 'lines and colours' that have already been established. Hopefully the LD will have a chance to influence choices made about those first lines and colours too, but that is not usually the primary focus of the role.

When light does lead design decisions, exciting things happen. Perhaps the most famous exponent of lighting-led scenography was the Czech scenographer Joseph Svoboda. Working in the middle years of the last century, he pioneered several influential techniques, including the creation of apparently solid objects using fine mist and 'curtains' of intense back-light, and the use of projected images (still and moving) onstage. A more recent exponent is Patrick Woodroffe. Perhaps best known for his work with the late Mark Fisher on stadium rock spectaculars for The Rolling Stones and others, his lighting-led design for the opera *Romeo and Juliet* for the Vienna State Opera in 2001 is well documented in John Offord's book.[6] Even when lighting design takes this leading role, however, it is still the servant of the text and the performers.

Designer as problem solver

Successful design of any kind is about finding solutions to problems. The problem may be how to make a saloon car exciting to drive and run on less fuel, or how to present the ghost of Hamlet's father onstage without getting unintentional laughs. It is likely that neither problem will be solved by a single person working in isolation. Just as many designers and engineers will work together to solve the car problem, so the director and performers, the designers of set and of costume, of light and of sound, and the wider team who realize the designs, will all contribute to successfully staging the ghost scenes in *Hamlet*.

Finding the key: why will the audience stay to the end?

In almost any live performance, those making it need to answer the question, 'What will keep the audience there till the end?' Narrative work, including most drama, opera, musicals and much dance, has at its centre a question. In Shakespeare's *Hamlet*, it could be: how will the Prince deal with the death of his father? In *Swan Lake*, will the Prince get together with the Swan Princess? In *Don Giovanni*, will the wronged father of the Don's Act One conquest have his revenge? In each of these pieces, there is a single scene where the answer is provided and the fate of the characters is more or less sealed – spoiler alert! Will Hamlet 'take up arms against a sea of troubles'? Yes, and there will be many

[6] *Lighting for Romeo and Juliet* by John Offord (ET Now, 2002).

deaths as a result. Will the Prince marry? No, but the wicked perish, the rest of the swans are released and the lovers ascend to paradise. Does the murdered Commendatore return? Yes and ultimately drags the Don down to Hell.

In each of these classic stories, the key question is posed early in the piece, influences much of the action building to the key scene, and the answer determines how the piece ends. Clearly the scene where the key question is resolved will be an important scene. The moments when the question is asked, which may be many, will also be important. Many of the other moments may be ornamentation, or distraction, necessary for the structure but of less central importance. So how will we find out what is the key dramatic question and which scenes are which?[7] The answer in most cases is to read the text and listen to the music. Not just in a casual way. We need to get inside the text and that includes the music when it is an important part of the text. We need to do some analysis. The process of text analysis can be intimidating to practitioners who see themselves as having a practical or visual focus, but it need not be, and it is necessary work for anyone wanting to play an active part in discussions relating to the making of the performance. A good knowledge of what happens when and where during the piece, as well as some notion of why what happens does happen, not only helps with design decisions, but is necessary in order to engage in intelligent discussions about the piece.

Initial text analysis[8]

With a published text such as a play script or music theatre score and libretto,[9] a lot of information can be gained from the opening pages of many printed editions.

A similar amount of information can be gleaned from sleeve notes of a recording, say of an opera, musical or band, and of course from reliable sites on the internet.

Once you have gleaned what you can from the covers and introductory pages, the next task is to read the script or listen to the recording (or possibly both), at least twice; first with your heart, then with your head – taking notes. Plays do not take long to read; even a three-hour epic is only three hours of speaking, and most people can read at least as fast as normal speech. If it is a play with a lot of characters, especially if they have unfamiliar names, it is a good idea to copy the page that gives the character list and a brief description of each character, usually found near the front of most play texts.

I find it useful to read a script through, or listen to a musical piece, quite quickly the first time, making just a few notes, reading or listening for a first impression – with my heart rather than my head. I record this first impression in rough note form, perhaps including brief character sketches, locations and plot elements. If you own the script, you can make marks directly onto it, for example simple underscores or stars in the margin where

[7] My question is not the only one in the piece, and there have been successful productions where other questions have been central. It is a good idea, however, for all the production team to agree on what the key question is, since this will determine the main focus of the performance.

[8] My thanks to director, set designer and teacher Phil Engelheart for this approach to analysis.

[9] The score is the notes of the music written down, and the libretto is the words for a music-theatre piece, normally just the lyrics or the songs, though it may include short spoken sections. For musicals with extended spoken passages, there is usually a document called 'the book' as well, and this is very like a play script. It is clear that music is integral to all forms of music theatre, including opera, operetta and musicals. If practitioners are not able to make sense of the music score, other ways of learning the music will have to be found. There is more on reading a score in the next chapter.

there are sections that excite you or that make you laugh. I also make a note to come back to any sections I don't fully understand at this point.

As I read or listen to the text again in more detail I will occasionally refer back to my initial notes, both to see how my impression of the piece changes, and to help highlight important areas of the text likely to be missed or misread on first reading or hearing, remembering that most audience members only see a performance once. I now start to make more detailed notes on each scene, often using a table such as the one below.

A story told through a play text usually contains far fewer words than one told in a novel or short story. In a play script we don't usually get full descriptions of places and people and we hardly ever get information about what characters are thinking. This means we often have to work harder on a play script to find out what might be going on underneath. When the play is eventually staged the actors will help the audience read extra layers of meaning; through voice, movement and gesture, supported by the production design. When we read a play script through we don't get any of that help. This first table enables us to look at how the story is told.

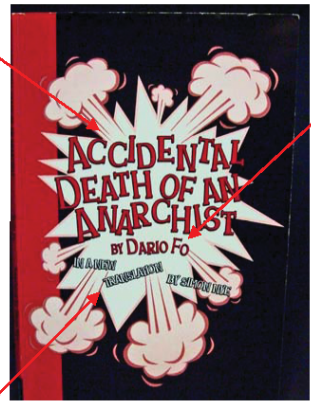
This format would work for a play already divided into scenes, with multiple locations and nine different characters. The table will have a different layout for each text. As we work through the text, a table like this one begins to provide a map of the piece and to give an idea of the key moments in the story; scenes where the plot simply unfolds, and scenes where the course of events is changed. It helps to identify that key dramatic moment, the key scenes in the piece when things change, and what they change from and to.

Table 1 A way of displaying the 'story' of a text

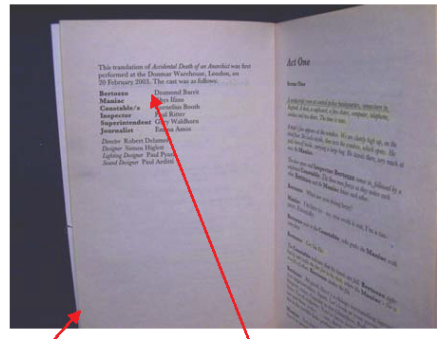
Act/Scene/Page	Location	Time of year/ Time of day	Purpose	Atmosphere	Character 1	Character 2	Character 3	Character 4	Character 5	Character 6	Character 7	Character 8	Character 9
1/1 p.1	A Courtroom?	Early morning (pre-dawn?)	Exposition and sentencing of a suspect or defendant	Fateful	On	On	/		E		e/l	/	/
1/2 p.7	The Port – outside	Not much later	More exposition & set-up	Bright but wary			On		On L		On	On L	E/L
1/3 P25	The Market Square	A bit later	First mistaken identity	Bright	/	/	On	On L		E	/		E

Brief Key: On means onstage from the beginning of the scene
On L as above but exits (leaves) during the scene
E means enters during the scene
E/L means leaves during the scene
Lower case means of minor importance (e.g. speaks less than two lines)
/ means that character is mentioned but does not appear

The title (and possibly a sub-title) of the piece, often gives a good indication of what the piece is about.



The author's name - is the name well known, and do you know any other works by the same playwright? What sort of plays does this person write, comedy, tragedy, farce? Does the playwright have a reputation for a particular political outlook or a particular mode or genre of production? What is his or her nationality, and does this person aim to speak for a particular section of that nation or a wider social or political grouping? If you don't know, find out.



Translation: If the play is translated, you might need to dig a bit deeper. What is the literal translation of the title? Often the English version changes the meaning, what was the original meaning? Was the play translated by a language scholar - who would ordinarily want to get the words as close to the original as possible, a playwright, who you might expect would be more concerned with making a play that works, perhaps at the expense of some losses elsewhere, or a poet, who might be concerned to make the words work again as poetry in their new language? If you have one type of translation (literary, stagy or poetic) can you get hold of a different type?

The list of characters appearing, (the Dramatis Personae) and often a short description of each. The list may be in order of appearance on stage, or in order of importance (to the playwright or editor).

Date of first publication, subsequent revisions and re-publications, translations, edited editions etc. You find out how old the piece is, which then gives a context with which to interpret the piece. This may help with particular words like "gay" which have radically changed in meaning since the 1920s, or with more general aspects such as the expected role of women in past times. Many plays and other published works are set "in the present day". If they are not brand new works, one of the first tasks of the production team will be to decide is which "present day" they are going to set their production in, the time when the play was written, right now, or some other time.

Many play scripts are published as the "prompt copy" of the professional production, and include the production credits for that production. This gives a further indication of how the piece was seen at that time. Did it receive its first performance in a large commercial theatre or at a subsidised repertory company? With a little research, the size and configuration of the original stage can also be found. Was the play written for a well equipped proscenium space, or a studio space? These and other considerations from the first performance may be written into the published text, but may not be essential to the successful re-presentation of the piece now in your performance space with your particular production infrastructure. In this case - find out about the Donmar in 2003. What sort of space was it? What was its artistic policy?

How long is the piece? Although it is easy to get this wrong, for many "straight" play scripts, a guess of between 90 seconds and two minutes per page of dialogue will give you an idea of how long the piece is likely to run at each performance. Some scripts give timing information, usually from the first professional production.

Figure 1 Annotated script 1, showing where to find basic information on the covers and in the opening pages of most play scripts.

Dario Fo's classic farce Accidental Death of an Anarchist was a sensation when it premiered in Italy in 1970.
Based on the story of a political activist who 'fell' to his death from the window of a police station, the original production was seen by over half a million people. This incisive satire on police corruption, media manipulation and political shenanigans is here translated by Simon Nye.
This version of Accidental Death of an Anarchist premiered at the Donmar Warehouse, London in February 2003.
'A marvellous concept: a zany political farce...' Michael Billington, Guardian
'Fo's play absorbs social indignation into mainstream Italian comedy' The Times
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ACCIDENTAL DEATH OF AN ANARCHIST
BY DARIO FO
Dario Fo
ACCIDENTAL DEATH OF AN ANARCHIST

Promotional material (often on the back cover). Leave nothing out when searching for a way to get into a script. If the publisher has re-printed a review, or offered a quick synopsis, read it - bearing in mind that its primary purpose is to sell copies of the script.

Other versions of the text can be useful for research too. A copy of an earlier translation may yield additional insights. Beside the 2003 copy is a script from an earlier production, a different translation. The earlier copy has a preface by the playwright, giving some background to the incidents mentioned in the play.

A very quick flick through almost any play script will reveal the number of acts (and scenes). The number of acts can give a guide to structure, especially with older work. Elizabethan drama developed a well known five act structure (still employed by many Hollywood film writers) while playwrights in the Nineteenth and early Twentieth centuries often wrote in three acts. In recent times there have been a number of plays written to be seen without a break - which has an impact on how the piece will be staged - no interval means no extended scene change taking 15 or 20 minutes. Other playwrights use the unexpected arrival of an interval to heighten suspense.

Figure 2 Annotated script 2, showing where to find basic information on the covers and in the opening pages of most play scripts.

Once we have an idea of the dramatic structure of the piece, we can start to do more detailed analysis. Many drama scripts can be read on a number of different levels, and at this stage it is important for our process to access as many of these levels as we can. For example, to discover more about the relationships between characters we might begin by reading any description given by the writer in the play text. If the character has a historical or mythical basis we can research that too. Back in the play text we can note everything they say about themselves and what others say about them and any specific behaviour detailed in the stage directions.[10] Doing this for each of the main characters in the piece can give you an insight into the structures that underpin the relationships, both those presented as *real* to the audience and those that might only exist in the minds of one or two characters. It can answer questions such as 'Who is in charge in a particular scene or act?' or 'Who might be secretly in love with whom?'

Another way into the text might be to examine the choice of any specified locations given by the playwright. Again, real or mythical places can be researched outside the script. This research, along with anything from the script that directly tells us about the places and times mentioned, is a useful source of inspiration for all the designers of a production.

Choosing which tools of analysis to use on a particular text will depend on many factors, including what type of text it is, how much time is available, and the preferred working style of designers, director and others involved. I like to have begun to get inside the text before any detailed discussion with the director takes place, but many practitioners work successfully in other ways. Whatever the approach taken, good work usually depends on collaboration between all those responsible for the look of the performance. This will clearly include the director, set designer costume designer and LD, but may also include a choreographer, projection designer, sound designer, musical director, performers and others. At this early stage in the process of making a production, your ability to bring ideas to the group and make creative contributions is severely limited if you do not have a thorough knowledge of the text – whether the text is a play, a set of songs or even a real-life event you are all going to stage.

Working with a director and other designers

Most performances are made by groups of people, and in most performance genres there is an established hierarchy to the group. In current Western theatre practice, at or close to the top of that hierarchy is the director, who usually has the ultimate responsibility for, and thus power of veto over, everything that happens in front of the audience. It is usually the director who will determine how the key dramatic moment will be built up to and presented, and how the consequences will

[10] Stage directions are the words in the script that the performers don't speak. In much Elizabethan drama they are short instructions, such as 'exuent' (plural of exit) and 'he kills her'. In some more modern plays the stage directions are extensive and quite prescriptive (e.g. the plays of Eugene O'Neill or George Bernard Shaw) but they are not always written by the playwright. Many 'acting editions' of play scripts are taken from the prompt book of the first professional production. In these cases the stage directions may be as much the work of the original director as the playwright. Debates about how much weight should or should not be given to stage directions rage in academic circles and among professional theatre makers, so they should be treated with caution. Talking with the director and researching the practice of the playwright and those involved in the first productions may well make it easier to decide how you treat particular stage directions.

be played out. Outside of theatre, this role is often less well defined, but it usually still exists – opera producer, dance choreographer, pop manager or lead singer for example.

Once in rehearsals, the director's primary role is usually to work with the performers to develop their performance. There are directors who involve themselves in the details of the design,[11] but usually after broad concepts have been agreed, the work of making coherent designs for set, costume, light and sound, and so on, becomes the responsibility of these designers. So how are these broad concepts arrived at? Most often through meetings of the creative production team. At first this may be only the director and the set and costume designers, but whenever possible, the LD should be involved too; if only as the 'second child' looking on and listening and asking questions as the 'drawing' is begun, and the first choices are made.

Hopefully after reading the script or listening to the work a few times (initial text analysis) the LD has a thorough knowledge of what happens when and where during the piece. This will not only help with design decisions, but is usually the 'entry price' to discussions about the piece. Without a good knowledge of what happens when, where and why in a piece, it is not really possible to take an active role in talking about *how* it will be presented. Going back to the children's drawing, it will be as if the second child does not know why the drawing is being made.

So having found out the when, where and why, it is time to begin active discussions with the director. For most LDs, at the heart of these discussions will be the question, spoken or

Meeting the director

For many younger designers (both LDs and other designers) meeting with a director, especially for the first time, can be an intimidating experience. It is worth having in mind the old saying, 'You only get one chance to make a first impression'. Think about how you want to be perceived by the director, and the rest of the production team. Will you be solid and technically competent, will you be full of artistic vision and flair? Will you be seen as able to facilitate other people's ideas and vision, as an originator of new ideas and as a contributor to an exciting end result?

Will you be seen as someone with whom the others can work or as a potentially dangerous independent who will only do things your way?

Wear the outfit that says the right thing about you and that you are comfortable with, make sure you know the exact place where you will be meeting and find out as much as you can about all the other people who will be at the meeting. If you have seen work by any of these people, be prepared to say something about your impression of that work. Have your own CV in your head so you can talk about your work and make sure you have everybody's contact details – and that they have yours – and always turn up on time.

Finally, bring a notebook and a few pens or pencils, not just to take notes, but also to draw with – many ideas can be expressed better in a quick drawing than with 15 minutes of chat and arm waving. Try not to leave before you are sure you understand all the concepts the director and other designers want to include, and that they understand yours – and that you all know when and where the next meeting will be.

[11] For examples of contemporary directors who take on design responsibilities for 'their' work, see Robert Wilson or Robert Lepage.

unspoken, 'What could lighting do for this production?' or it could be rephrased, 'What does the production gain by having directed light rather than the flat white light of most rehearsal spaces?' The director or the set designer may already have an answer – in which case the next question is: do you as LD understand that answer, and are you happy to work with it? You may have an answer, or a partial answer, but can you 'sell' it to the rest of the team? There may be no answer at initial meetings, or a confusion of answers, some of which may be contradictory, but the LD must keep the question in mind as the production (and the lighting design) evolves.

Selling your ideas

Not every collaboration is perfect – and even some pretty good ones have troubled times. When the director and a designer disagree on a point of interpretation or realization, we can talk, diplomatically perhaps, about creative tension and how great work comes out of a clash of strong personalities. By and large, resolving these different opinions requires rigorous examination of why each party might be right, illuminating and informing more thoughtful final choices. Many LDs often find themselves becoming a mediator between a strong-willed set designer and director, working to somehow help realize the slightly contradictory dreams of both into a coherent production concept. This generally works best when the LD is informed by their own rigorous research. (Here is another indication of the range of skills often needed to work as a professional LD, which include an ability to mediate and negotiate, as well as to research.)

Often when a designer is 'selling' an idea to a director and the other members of the production team, their best support comes from research. A concept supported by intelligent and rigorous research – of the text and beyond – has much more appeal that some piece of whimsy proposed because it might look nice. After all, the director is going to have to work with the design concepts that establish the world of the performance to help the performers create their performances. The director must believe in that vision of the performance world at least as much as the designers do, so the designers have to provide as much underpinning material to support and justify the design decisions as they can. The producer is going to have to find the money to pay for the creation of this world, so they may need convincing too.

Through all the almost inevitable arguments (friendly or otherwise) that accompany the evolution of a production, we need to remember who is ultimately in charge. In most cases this is either the director, who carries artistic responsibility for the production, or the producer, who carries the financial responsibility. In theatre it is rarely any of the designers! In most situations, when the LD and the director significantly disagree, the LD has only two real choices – do what the director asks or quit. If the LD and the director maintain a good working relationship, the likelihood is that a practised LD will be able to persuade the director to their point of view, especially if that point of view is backed by research – so keep researching and keep talking.

Of course, there is no reason other than tradition why the designers cannot lead the interpretation of the text onto the stage. There are working designers at all levels whose contribution to live performance goes far beyond providing a setting, costume, lighting or sound. Although these designers are by no means the majority, they may well be a vanguard for a new practice that will refresh live performance for a much more visually orientated generation. The basis of this

practice is, more often than not, rigorous research, not only into the text and all that is implied by the text, but into the audience – its experience and expectations, the venue – its facilities, history and perhaps unconventional use of its spaces, into technology, both old and new, and of course the art and practice of the performer – still at the heart of almost all performance. These designers are taking on some or all of the role of director, following in the footsteps of Appia and Gordon Craig. To be part of this movement, a practitioner must research widely, looking outside the confines of their own specialist area, be that set, costume, sound or light.

Further research

Whether or not the designer is taking on some of the traditional role of director, most productions will benefit from some research beyond the original text. Researching the author of the text, the period in which it was written and the period in which it was originally set will all be useful as background. Some playwrights have created a definite style of presentation for their work – for example Bertolt Brecht's Epic Theatre style, particularly as practised at the theatre he helped to found, the Berliner Ensemble, or the opera composer Richard Wagner's Gesamtkunstwerk[12] style, as practised at his Festival Theatre in Bayreuth. Even if the style is inappropriate for the current production, some knowledge of the author's original presentational intentions is often useful in deciding on an appropriate style for a contemporary production, and in deciding what to keep and what to throw away from the text as written. For example, discovering that a particular stage direction or scenic description is likely to have come from a particular production rather than the author will often help the production team decide how closely to follow it.

Period choices

One of the key early decisions for a production team is when in time to set the piece. Many scripts state a particular date, and refer to specific historical events, and this can take the decision out of the hands of the production team. But what happens in the case of a play written, say, in 1960, and set 'in the present day'? The production team may choose to use the original dates, to bring the whole thing forward to the present 'present day' or to choose some other date. Each choice will have consequences for the visual design (and probably the finished script too).

For older works, including those often referred to as classic texts, choice of period can offer the audience a different perspective on what might be a well-known story. Take as an example the case of a production of Shakespeare's *Macbeth*. It could be set in eleventh-century Scotland, the historical time and place of the story Shakespeare used. The play has successfully been set in any number of other times and places: in contemporary times in an unspecified Western democracy or quite specifically the Uganda of African dictator Idi Amin. It has been set in the confusion after the First World War or in the American West of the early nineteenth century, and no doubt will be set in space if it has not been already.

When the creative team are deciding on a period, it is important to understand the context of the author's original choice and its impact

[12] Gesamtkunstwerk literally means total artwork, and encapsulates Wagner's concept of many elements coming together to make a greater whole – music, poetry and visual elements. The word came to stand for the house style of the Bayreuth Festival Theatre during Richard Wagner's time there, and for many years after his death too.

on the piece. It is likely that Shakespeare chose medieval Scotland for a number or reasons, including the fact that the period was sufficiently distant from his own troubled times for the authorities to find it difficult to accuse him of making trouble for the reigning monarch. But *Macbeth* cannot be set literally anywhere – there has to be a suitable power structure, for example.

Often with a play such as *Macbeth*, no specific time frame is given for the production, allowing director and designers to play with ideas from historical and contemporary experience. A definite period means choices can be informed by historical research and there is usually a 'right' and a 'wrong' answer. Without a definite time to reference, what is right or wrong for the piece can be much harder to determine. When the production choice is for no specific time and place, every item onstage, every prop, every costume and every scenic element, is open to be read for its greater significance. For example, why is the king armed with that particular gun, well known as the weapon of choice for a particular real person or group? Why do his personal guards wear those particular uniforms, a stylized version of a particular present day or historical army? What is being alluded to here? Is the audience being asked to draw parallels between the action onstage and the individuals or groups referenced in the choice of weapon and uniform? These extra meanings, perhaps offering an audience insight into their own present or recent past, can easily be enhanced or undermined by light. What would be the point of the particular choice of weapon if it is always in deep shadow and the audience never see it? Could the inclusion of searchlight effects into key scenes enhance references to the grandiose authoritarian regimes of Hitler or Stalin perhaps?

Sometimes the LD will have a more direct need to do historical research. One of my first mentors, a set designer, told me that if you put something onstage that should not be in that world, it will upset some members of the audience, and spoil their experience of the performance. He was talking about my proposed use of a fluorescent fitting in a kitchen for a play set well before fluorescent fittings were invented.[13] Historical research for LDs might begin with what light sources can and cannot legitimately be used on a set representing a particular period. It might go on to finding out what the light from period fittings looked like – the light from gas mantles, for example, has a pale greenish tint. In collaboration with set and costume designers, it might include an investigation of what were the fashionable and available colours for clothing, for wall coverings and for furnishing at that time and in that place. As we have already said, it can usefully extend into more general information about the period – many working designers would agree that any research is useful and the more you know the better informed your work is.

Location

Locations too will often require research. The light inside a particular building, or outside at a particular time of day and season, can be quite specific. To evoke that place and time, the production may well wish to evoke that quality of light onstage, so the LD will need to research

[13] GE began selling fluorescent lamps in North America in 1938. It did not take long for their use to spread, partly because of the relatively high cost of electricity in many markets. But you can't authentically put one in the kitchen of a play set in 1925 (not forgetting that they looked quite different in 1938 to the ones you can buy at the electrical wholesaler today!).

what it should look like. Often it is not the exact light of a particular place we need but the essence of that light, perhaps as captured in an iconic image – a photograph or a painting. The essence of the specific light of a place and time can be very hard to explain in words, and many of the words that a practising LD might use to do so would not be understood in the same way by other theatre professionals. So use pictures. Two people looking at a flat still image may still not have the same expectations of a realized version of the light in that image, but high-quality images will allow discussions about light to begin with all parties much more confident that they are talking about the same thing.

Several designers I have talked to try to introduce something they have not worked with before into each new performance design. This could be part of their research into technology (in its broadest meaning) and could include resurrecting some old piece of stage machinery or magic just as easily as it could mean using the latest digital projector. The point is not to come into the production with technology for its own sake, but to ensure that whatever means are chosen to realize production ideas they serve the creation of the world of the performance. It is worth remembering that stage technology rarely 'does exactly what it says on the can' – so some of your research will be into finding out exactly what your new kit does and how – preferably before the increasingly time pressured rehearsals in the venue.

The space and the lighting design

The text (whatever it is) and the collective response of the whole creative team to it are only ever part of evolving the concept for your lighting design. The other big influence on the development of most lighting designs is the space in which the performance will take place. In most productions, we can think of space in two different ways. First is the space envisaged by the set designer, usually on a stage, the set design. Second is the larger space in which the performance takes place. Your response to the designed set will help you decide what qualities of light from which directions will help to tell the text's story. The second space, the theatre, concert hall, opera house or whatever, will often largely dictate where and how you can hang lighting instruments that will enable you to create those qualities of light. For now I'll just consider the space of the set design, however.

In many production collaborations, it is useful if the LD is involved in discussions about the set design at an early stage. Conversations may revolve around detail – what texture or colour a particular element might be to work best with the lighting ideas – or may be around the nature of technical changes needed to realize lighting ideas – adjusting the angle or extent of a ceiling or creating slots through which light can enter at a useful angle, for example. In the closest collaborations, the overall concept is shared by the set designer and LD, as with some of the work of set designer Rae Smith and LD Paule Constable. In some of this work it becomes difficult or even unhelpful to define which elements of the overall visual design are the work of which designer, so interlinked and co-dependent are the elements.

The model box

Despite the increasing use of digital means of drafting and 3D modelling, most theatre designers still make use of a model box, a scale model of the theatre space and the stage design.

In the UK most model boxes are made in the scale 1:25 (usually 1:24 in North America). Many

Figure 3 An image from probably the most widely known collaboration between Paule Constable and Rae Smith, *War Horse*.

set designers (and directors) use the model box to develop the set design (and the blocking and overall concept of the piece). It is also a useful tool for solving all kinds of production problems, such as how to transition between two scenes, how to get a large number of performers onstage or offstage quickly, or how to get the right quality of light into this or that area of the stage.

The level of detail present in the model box of a stage design can vary a lot. Generally, the creative team responsible for a production will need to get the go-ahead from the producer for their visual concept, if only to make sure there is enough money and other resources available to realize it! For this and other reasons the model box will often start life as a 'sketch model', sometimes called a 'white card' model – to test the feasibility of the overall concept. Is there enough of the right kind of space for the director to stage the performers? Can everyone in the audience see what they need to see, and can we adequately hide what we don't want them to see? Are the major elements achievable, in terms of build costs and safety? If the LD is involved at this stage, it is important to be thinking about both the possibilities that the set design offers but also about the restrictions it may place on your lighting design. Is it going to be possible to achieve the kind of light you want?

Once basics have been agreed, it is usual for a more detailed model to be made – detailed enough for the production team to be able to source, make and paint all the various elements, and also detailed enough for the LD to

Figure 4 The model box for a production of *On The Razzle*, designed and built by Phillip Engleheart

be able to try out some ideas, for example angles and colours.

Where is the light coming from?

Many stage sets are representations of 'real' spaces – a domestic interior or a blasted heath, for example. The starting point for many professional LDs is, 'If this space were in the everyday world, how would light get into it, and what would it do once it is there?' If the text has already told us that sun is streaming in through the windows, questions such as 'Where are the windows?' or 'Where is the sun?' are usually answered by the set design. This provides a motivation for where the light in the room should appear to be coming from. If the text tells us a scene is set in the open air, a starting point for the LD will often be how best to use light to reinforce the impression that we are indeed outside. How to achieve the right shadows? How to illuminate the key features as if they were lit by the sun (or the moon, or street lights)?

What will light do for this set?

A set design is not complete until it is lit. If you doubt this, look at a striking dynamic set under dull flat working light. Light can play a fundamental role in the way the set design helps to tell the story of the piece, and most LDs seek

inspiration from the set design as much as from the text. How might light play on a sky cloth or cyclorama, helping to tell the story? Can a doorway or other opening provide a potentially exciting way in for light? How does the texture on a wall take light? Can a striking element of the set design can be transformed by changing the quality of the light that hits it, or by lighting it from a new angle? Will changing the material from which an element of the set is made increase the potential for light?

LDs need to be constantly noting how different materials respond to different qualities of light, from different directions. This kind of learning is never completed. As well as noting the interaction between light and materials in our everyday world, we can make specific experiments, which become more exciting when done in collaboration with an engaged set designer. In the production of *War Horse* shown in Figure 3, Rae Smith and Paule Constable, along with the rest of the production team at London's National Theatre, did a lot of experimenting at full size with different materials for the larger scenic elements, looking at, amongst other things, how each reacted to different qualities of light. This kind of experiment is referred to as a *Bauprobe*, a German word that literally means build-rehearsal, but more usefully can be thought of as a try-out at full size. This kind of experimenting is very useful, especially for less experienced designers (though nobody would call the team behind *War Horse* inexperienced). Great designers never stop experimenting. Even when it is not possible to set up a full *Bauprobe*, it is often possible to experiment at or close to full size to see what light of various qualities can bring to dominant elements of the set.

How much work does the audience do?

Performances at Shakespeare's Globe Theatre, both the original sixteenth-century building and many of the productions at the modern re-creation on London's South Bank, generally use the minimum of representational cues to evoke hundreds of different locations and times; from the castles and courts of *Macbeth* and the English kings, to the Roman forum of the Caesars, from the gardens of Padua and Verona to the blasted heath of *King Lear*, and dozens of battlefields. All of these many locations are presented at different times of day; from pre-dawn through morning, afternoon and evening, to midsummer's night. For this style of production, the audience reads time and place through the action of the performers and the language of the play; and this is possible on other stages too, and with writers other than Shakespeare. It may be considered easier to successfully present narrative work with very little representational set or lighting when the stories are already well known, and when the language is powerfully provided by the world's greatest dramatists. Certainly costume helps the audience to enter and comprehend the world of the performance offering information about period and relative status of the characters. The present-day Globe company put a great deal of effort into costume, for example. But the audience for live performance, for theatre especially, are very often willing and able to 'fill in the gaps' around the performers. The British stage designer Jocelyn Herbert,[14] working at the Royal Court Theatre in London from the 1960s onwards, with others including

[14] Stage designer and artist Jocelyn Herbert (1917–2003) was a seminal figure in post-war twentieth-century British theatre. Her extensive archive is now housed at the National Theatre in London, where she did some of her best known work.

LD Andy Phillips[15] and director John Dexter,[16] pioneered a style of set design where the right table and chair sitting on an otherwise bare open stage could represent a whole room, with walls, doors and windows if not an entire house. The audience did the work of creating whatever was necessary for the world of the performance around the images Herbert and Philips put onstage – made 'real' by performers and director.

When we watch productions made for film and television, design generally provides an accurate and detailed representation of the world of the performers – live performance does not always need this. Sometimes an over-representational staging gets in the way of a live performance. The willingness and ability of a live audience to imagine part of the world of performance, above and beyond the 'missing' fourth wall of proscenium theatre, can provide the designers with a freedom of expression not usually available to designers working in recorded media. Design for live performance can often do much more than represent time and place, providing an emotional context and visual interest, as well as giving the audience something to think about. Even when the chosen aesthetic is to re-create as closely and completely as possible a very particular world, there are choices open to the design team that allow their work to convey more than simply time and place to the audience.

Expectations and genre

Design for performance, as we have said before, exists to support the performers. This means that there will always be some practical constraints on performance design. Almost all performances need at least one entrance/exit on the stage, to get the performers on and off if for no other reason. Productions that feature dance will need room for the dancers to move, and lighting positions to provide good modelling of their forms when they do move. Designs for performances that feature amplified sound will need to incorporate the technical requirements of speaker and microphone placement, and if there is a band onstage, all the equipment that goes with the production, control and separation of sound too.

There are constraints on design imposed by the expectations of particular genres. The majority of the audience for musicals, some opera and ballet, and most rock and pop concerts are often said to expect the 'stars' to be lit by follow-spots, and it can be difficult for an LD to argue against their use. Other types of drama demand that no performer is ever seen by the audience in anything but full light – no matter what the dramatic time or place may indicate. Either of these conventions can be accepted and worked with or challenged, but the LD and other designers are not likely to be able to challenge convention if the only argument is 'I don't like that way of doing things'. If the design concept is moving away from the conventions of the genre, realization of it will often produce something new and exciting, but it still has to be 'sold' to the creative and production teams, and quite likely the performers too, in order for it to ever get onstage.

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[15] Andy Phillips, who died in 2004, was head of lighting at the Royal Court Theatre from 1964 till 1972. He lit productions all over the world and was twice nominated for Tony Awards. He was known for his bold style, and a restricted colour palette, often using only light-blue colour correction filters. He was also a founding member of the equipment rental company White Light (with John Simpson and fellow LD Rory Depmster) and of the Association of Lighting Designers (ALD).

[16] John Dexter (1925–1990) was a multi-award-winning English theatre, opera and film director. He worked internationally and was at various times an associate of the Royal Court Theatre and the National Theatre.

Next steps

So by now we are a little less than halfway through a design for performance process. A 'we' has been established, a creative team who have begun to imagine this piece in a performance space. We have become immersed in the text; knowing what happens where and when, and why it happens, and knowing each of the characters in the piece and what function they serve – hero, villain, love interest, lead guitarist, drummer, and so on. We have a good idea about the structure of the piece, where the climax/es is/are, which bits are there for comedy, for exposition, for character development and maybe for ornament. We have some design concepts, based on rigorous research both of the text, the space of performance and of other things that have proved linked, useful or just interesting. As LD, you will have begun to collect some visual material to illustrate discussions about these design concepts – certain qualities of light perhaps required for particular parts of the piece – perhaps some photographs or a reproduction of an iconic artwork. But we are still a long way from a realized production, and you as LD are still some way from a lighting plan, let alone a set of lighting states that go with cues in the piece. The performers may not even have been hired yet (though if this is the case the costume designer may be getting nervous). Here are a few things to bear in mind as 'we' enter the next stage of the design process; first about the concept:

- The concepts we take into the next stage of the design process should be free to grow and evolve during their development, and respond to what the director, the performers and hopefully you too are discovering during rehearsals.
- Very soon, however, the concept will need to become firm enough to provide a framework in which all can move towards a coherent realization. You may have access to a model of the set design, which might be real or virtual.
- You may have access to a model of the set design, which might be real or virtual. In either case you will need scale drawings of the space (the ground plan and section), showing the proposed position of the set and performance area, the audience and as much of the technical facilities as necessary.

About the nature of (almost all) live performance:

- It will be seen by many audience members at the same time, observing from different angles and often from a distance – you can't get away with a design that is dependent on a single point of view.
- The stage is not the real world – even in verbatim theatre[17] – performance demands a heightened reality – even if it produces it itself. Attempting to slavishly replicate the 'real world' onstage is rarely useful.

And about choices and time:

- Choices diminish as the time left before 'first night' tends to zero. For example, six months

[17] Verbatim theatre uses the recorded words of 'real people' and presents them on stage. Examples include re-enactments of infamous trials or inquiries, and dramatic investigations into disasters. This is perhaps the style of theatre where there is often the greatest wish to represent an un-mediated reality on stage. However, we should remember that even in the verbatim presentation of an inquiry, some necessary editing of the total content available has taken place to produce a text that makes sense to an audience in a single evening, and there are justifications for taking the same approach to the visual design.

from the fit-up you can have special equipment made just for your show. Six weeks from the fit-up you will probably have a choice of equipment that exists already, maybe in other towns or cities, maybe in other countries, since there is plenty of time to organize getting it to you. Six hours before the fit-up you will have to work with what is on the truck, in the space already, or perhaps in the hire shop down the road. Six hours before the first night you work with the cue structure you have and the equipment that is rigged and focused, and you make only small (but frequently important) changes.

- At each stage, try to get agreement on which elements of the production are fixed and which may still change. Be prepared for surprises, yours and other people's, and try to build flexibility into your design.

5

Evolving the concept, developing a cue structure

Stage 2: design ideas begin to be made real

For most mainstream theatre productions, we would now be at the stage just before rehearsals begin. The set design has been more or less completed, and a scale model of the set has been made. Ground plans have been drawn and construction of major scenic elements will probably have begun. The cast have been hired, and the costume designs are already being realized in the workshops. But we are still some weeks away from anything happening on the performance stage, and production ideas will evolve and change as the director rehearses with the cast. While the major scenic elements are now fixed, and some costumes have been made (and can therefore not change without extra budget being found), lighting, sound and sometimes projected design elements can still evolve as the production does. This possibility will often give LDs (and sound and projection designers) both considerable creative freedom to respond to the evolving production ideas, and huge headaches trying to balance creative freedom with practicality. All too soon the LD will have to submit a request for equipment and personnel. The choices made will help the LD achieve design ideas while at the same time making it harder or impossible to achieve other things. For example, once the budget has been committed to a rig of moving lights or intricate hanging positions, it often can't be spent again on specialist cyclorama lighting or complex practicals.[1]

Some practical considerations

Once the LD has immersed themselves in the text, and met with the rest of the creative team to establish common approaches and goals, they

[1] A practical is something that is part of the set that lights up. This may be a chandelier (flown from the theatre's flying system or permanently attached to the ceiling of the set) or wall light (sometimes called a sconce) or table lamp. It might also be a TV or computer screen, a mobile phone, or anything else that sits on stage or gets carried by a performer. Although sometimes the performer can control the light emitted by a practical (through the switch on a table lamp or the controls on a smartphone, for example) very often we want the practical made so that the light emitted is controlled by the lighting desk.

should have some idea of the answer to the question, 'What does lighting do for this production?' There are practical matters to attend to. These relate to:

- The size and configuration of the production space(s), usually documented on a venue ground plan and section, or better still (for some) a 3D CAD model ready to be viewed on computer.
- The production infrastructure of the venue(s), sometimes known as the 'in house' facilities. This includes such things as: number and position of installed dimmers, available power supply, lighting and other equipment available for our production, and often most importantly the personnel available.
- The overall budget and the expectations of the people or organization providing the money. Do they see this as a highly polished extravagant spectacle, a 'rough and ready' rapid response, or something in between?
- Time – an LD will need a very different approach for a show that must be in, up and out in a day, to one that has a month of rehearsals in the theatre followed by weeks of previews.

It can be difficult to make plans for a lighting rig without most of this information. However, it may be some time before all these things become clear. Working with limited information is a problem we will look at again in later chapters, but for now let's assume that we are not in that position. So as LD you have had several meetings with the director and the other members of the creative team. Together you have had discussions about the world you are working together to create. Those discussions continue to be informed by your research, both text-based and practical. The team have agreed the main elements of the set and how they frame the performance, and the spatial relationship between audience and performers (where the audience is sitting/standing in relation to the performers).

At the same time, in discussion with the production manager and others, you have a clearer understanding of practical matters such as the budget, and the time, equipment and personnel available.

As LD, you have a thorough knowledge of the script, and some ideas about how you might eventually realize performance lighting onstage, and some answers to the question, 'What will lighting do for this production?' Time then to go into some detail, and start to make plans.

An LD and team will usually want to produce two distinct types of document. The first type of document includes the rig plan or lighting plot, and this is the primary concern of the next chapter. The second type of document includes the cue synopsis – a document that will evolve throughout the production period and will ultimately contain important information about the purpose of each lighting state and how that purpose is achieved, the placement of the cue within the piece and the nature of the transition from one state to the next.

Lighting score

Most performance lighting is made up of a number of different looks which we have called lighting states or cue states. Each lighting cue triggers a change to a new cue state. Like Method-trained actors, lighting cues usually need a motivation. This might be something obvious – such as a cue required to brighten a room setting when an actor turns on a light switch or the rapid increase in intensity at the end of a dance number in a conventional musical (known as a button cue

or bump). At other times, a cue provides a subtle change in atmosphere over a number of minutes, motivated perhaps by the mention of a sunset or the intention to slowly change the feel of the performance from 'normal' to 'threatening'. To find the motivation for each change in the lighting state, the question 'What will lighting do for this production?' needs to be asked for each moment of the production, each dramatic unit or scene, and each transition. 'What will light do for this scene?' For drama and many other production genres, a good way for developing LDs to begin to formally answer these questions is by producing a 'lighting score' – building on from Table 1 in the previous chapter. This can then evolve into the first cue synopsis, and form the basis of our whole approach to creating the light for the piece.

What we are attempting to achieve with the lighting score is to record practical and artistic requirements for each major moment in the piece. At first, the LD may only be able to make abstract responses to both the text and to concepts expressed by fellow collaborators on the project – the director or producer, other designers, etc. Later, the LD can respond to the set design and by watching the production 'get on its feet' – usually in a rehearsal room – will be able to see more clearly which areas of the performance space require what kind of light at different moments. Often slowly, concrete ideas about the quantity, quality, colour and direction of light required to best serve each moment of the production emerge, and turn into lantern choices at each of the lighting positions to be used for the production. Ideally, the LD should try not to hurry this process, being prepared to go back over sections of the text and re-work ideas in the light of new discoveries from later sections of the text, from discussions with other members of the team or from rehearsals.

In my lighting score, the piece has been divided into dramatic units. Exactly what a unit is composed of should change to reflect the text and how detailed an approach is being taken. A unit is simply the smallest part of the text that can conveniently be considered in isolation. For a piece already made up of multiple acts and short scenes, each scene might constitute a unit. For a multi-character drama each entrance and exit might define a unit. For a musical theatre piece, each song might be a unit, but might also usefully be split further into sub-units – verse, chorus, middle eight, and so on. The beauty of using a computer to make this table is that you can split units up at will – a disadvantage may be that you can't easily sketch on it until it is printed out.[2] Whether the lighting score is computer generated or hand drawn, when you decide on the layout, it will probably be most useful if the squares that ask for a visual response are not too small.

For most LDs, what works best in the early stages of a production is to record their emotional response to a unit, a step towards later decisions concerning what quality of light is right for each moment rather than a direct leap to specifics of lantern type, position, focus, colour, and so on. For example, the colour section of my lighting score asks 'If this scene was a colour what would that colour be?' rather than 'What colour will I light this scene in?' And the intensity section asks 'What (emotional or psychological) intensity does this scene have?' rather than directly 'How

[2] The increasing sophistication of computer software, however, begins to allow designers of all kinds to develop 'digital' practices, which can include sketching, in two, three or even four dimensions (the fourth being time) quickly, within more conventional documents such as tables and spreadsheets. This is clearly a rapidly developing area which we will touch on again later.

bright will I make this scene onstage?' This is not to say that impressions recorded in these sections of the lighting score or elsewhere will not eventually feed into choices of colour or the overall intensity of a cue, but that the primary purpose of the document is to develop ideas.

This lighting score does have some sections that will provide practical information to feed directly into the placement of fixtures: direction of key light – that is the direction of the 'apparent' source of illumination – numbers and positions of performers and area of primary focus and details of any specials we might use, for example. Using this document, we can begin to imagine the quality and quantity of light onstage at any particular moment – and from that we can begin to imagine what equipment placed where we will need to achieve that.

A note of warning

If you observe established practitioners at work, you are unlikely to find them producing a formal lighting score as extensive as the one shown here. By the time most practitioners can earn a living as LDs, much of this process has become instinctive. If it is documented at all it is in a form of a personal shorthand that helps the LD to draw on their extensive technical and artistic experience, often written directly into a copy of the script or score. The lighting score is offered as a shortcut to evolving a lighting design for the less experienced practitioner, but it cannot replace that experience.

In the performance space, the LD will often have only minutes to work with the console operator or programmer to create the exact composition of each major cue state. Extensive preparation is often the only way to create lighting that truly serves the production in these circumstances.

Figure 1 (opposite) shows an example of a lighting score (from R.H. Palmer, M.A. Jones and others).

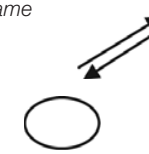
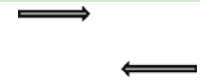
Using the lighting score

The lighting score is a tool that can help an LD evolve a consistent visual language for a piece. It can be used to note and develop your visual ideas and practical requirements of the production. It can help to give a unity to a design by presenting the elements in one place. It can help to reveal underlying rhythms and structures: between 'bright' and 'dark' scenes, between high and low contrast scenes, between open and confined scenes, and between scenes with different colour feels. From this you can begin to construct a cue synopsis. Remember that it is a tool, not an end in itself. It should be used to help you develop and record a general approach to the performance lighting, and it is not so important to complete each square.

Working with music

So far the approach to breaking down the text into something we can use as an inspiration for design has largely assumed a written script. For a recorded musical text, such as a full recording of a musical or an opera, the process is much the same, though it helps enormously to have the libretto when it comes to trying to work out who is onstage and where each scene is set.

Musical training or knowledge can be very useful in making responses to music, but as long as you can respond to the music – allowing it to affect you in some way – you can find a way into it, and produce some design ideas. (If you don't feel anything on hearing the music, perhaps you should not be working on the piece.)

	Unit/page number	Kind of content	Unit 1 Act 1 Scene i	Unit 2 Act 1 Scene ii
*Primarily from the text & discussions with artistic collaborators**	**Key Idea/Reason for the unit**	*Words*	**Exposition/Sentencing of Father to death at sunset**	**More exposition – intro of Twins A**
	Time & Location	*Words*	**Court Room Early Morning (pre-dawn?)**	**Town Square? A Wharf? 'an hour before dinner' (11 a.m.?)**
	Intensity (Emotional/ Psychological)	*Graph*	**HIGH throughout**	
	Colour (Emotional/ Psychological)	*Paint, gel sample or words?*		
	Mood (Conflict/ Aggression/Passion, etc.)	*Words*	*Grim acceptance of fate? (find out in rehearsals)*	*Wary/Conspiratorial then Rising anger & confusion*
*From Rehearsals & Scenic Design/Model Box**	**Tempo of Scene**	*Graph?*		
	Entrances/Exits Use of Stage Area (blocking) Area(s) of Focus & Implied Sources of Light	*Sketch Ground Plan with arrows & notes Words?*	*Duke (and attendants)* *Aegeon (and Gaoler?)*	*Enter from USR. D of S Exit DSL D of E from USL & All exit same* 
*Design decisions that will influence type and placing of equipment**	**Overall Brightness**	*Graph?*		*Getting hot?*
	(comment)	*Words*	*Two Pools?*	*Bright Daylight*
	Openness/Closure of Space	*Words/graphic*	**High/Oppressive**	**Open/Outside**
	Key Light	*Arrows?*		
	(comment)	*Words*	*Strongly side lit? Opposite sides?*	*11 a.m. shadow length?*
	Amount of Contrast	*Words or shading?*	**Chiaroscuro?**	**Moderate**
	Lighting Specials	*Words/Sketch*	**Maybe area defining top-light specials**	**None**
	Movement	*Sketch? Arrows?*	**Check blocking of entrance/exit**	

* These divisions are for guidance only, and may be quite different in some production set-ups.

Figure 1 A lighting score.

When working with music I find it useful to start by making a response to each song or musical number along the following lines:

- Who is involved? What are their roles in the piece?
- What is the number about? Is that important, or is the number just a pretty filler?
- Size: Does this number 'look' big or small? Solo, duet, chorus? Is much movement likely in performance?
- Are there all-out dance sections? If so, how many dancers will there be? Does the dance tell a story too?
- Shape: Does it start small and grow? Does it grow slowly or dramatically at a particular point? Are there changes, in rhythm, in atmosphere or in musical key? What happens at the end – big finish or gentle fade?
- Texture of the music: Is there one simple melody, or are there counter-melodies and complex accompaniments?
- Emotional response: What feelings does the music evoke in me? Does the tune soar between powerful high notes leading the accompaniment and appealing to the heart of the audience, or maybe the words are most important, or the music is complex and the appeal is to the head?
- Colour response: Does the music make me think of a particular colour? Is it multi-coloured or monochrome? It is usually a bit early in the process to get too tied into particular tints and hues, but more generally does this feel like a 'blue' song, or maybe a pink and amber number?
- Brightness: Again, usually too early to be thinking about the intensity of individual lanterns, but does the number 'sound' bright or dark? You might consider placing each musical number in the piece on a scale of brightness, say 0 to 10, and see if this reveals something useful about the overall structure of the piece.
- Is there anything about the song that suggests a particular angle of incidence or throw? For example, a ballad about loneliness or loss might make me think of using a strong and clearly visible back-light beam.

As with the table in the previous section, this list is clearly not exhaustive. I use some or all of these factors as a starting point to help record my immediate response to the music.

Many designers for pop and rock music concerts use a similar approach to that outlined above when evolving a design – deciding what each song will look like. Is this a 'blue and red' big song with a bright chorus? Does it have a lot of quick cues or is the look based around one massive statement for lighting that grows or shrinks throughout the number? Without the support or perhaps constraint, of a 'story' running through the whole evening, designers for live music concerts may need to find themes to tie individual numbers together, and to ensure that similar sounding numbers don't all look the same – so there is clearly more work to do for a rock and pop LD just as for a music theatre LD.

Collaboration with music and sound design

When thinking about the creation of most types of performance, the signification at any one moment will come from many different channels. No single channel of communication between stage and audience should usually try and do everything, whether that channel is lighting, sound, set or the many channels available to each performer. Almost all live performance

The musical score

The score is the written record of what each instrument or group of instruments (each 'part') is doing through the piece. Most music is divided into 'bars', each containing a specified number of beats. Most pop music and a lot of other Western music has four beats in a bar. Usually the musicians playing for opera, musicals and some dance are led by a conductor. Each time the music begins a new bar, the conductor or band leader gives a 'down beat'. This helps the musicians to play together. In a full score the notes are written out, bar by bar, with a line of bars for each part. In an orchestral number 'scored' for many parts, each page of the score may have as little as five seconds of music written out on it – clearly a full score for such a piece will be a large book! Often the LD (and others who need a written copy of the music) will use a 'piano score' or a 'vocal score'. This is a condensed version of the music, often used for rehearsals, written for piano – so the many lines or parts are reduced to two for the piano (one for each of the pianist's hands) and a line or lines for the singer's music, and the words. This is more manageable, though for a long opera it may still be quite a size!

Every score is marked up with section markers, usually capital letters printed in bold, or bar numbers. They allow musicians to identify where they are in the music. In rehearsals, the conductor might ask everybody to begin 'eight bars after figure G'. Section markers are also useful to the lighting and stage management team when it comes to discussing where the lighting cues go.

Score reading is a useful skill when working with music theatre (that is opera and musicals) and dance. In many large music-theatre and dance productions there will be an assistant following the score so that the LD can concentrate on looking at the stage. When it comes to placing cues with the music, this assistant can give a clear instruction to others about where in the music each cue goes. Having the skill to do this well can be a good way to start working in larger-scale music theatre.

Accurate score reading requires a good deal of practice, but with a rudimentary knowledge of written music it is possible to follow roughly what is going on. Having the words in your score will help for the sung passages at least. Listening out for a particular musical phrase – maybe a flourish from the trumpets, or a change in bass rhythm, can give clues to link what you are hearing to what you are reading in the score. Some knowledge of music, preferably from playing an instrument, will help too, not only with reading the score but also in understanding some of the ways music 'works'.

Finally, two cautions. First, make sure the section markers in your copy of the vocal or piano score are the same as everyone else's. Second, beware repeated sections of music that are not written out in full, and check with the music department which (if any) repeats will be played.

requires the collaboration of all those responsible for these many channels to be successful.

Even when there is no music as such onstage, the power of sound to evoke place and atmosphere should not be left out. For example, multi-location plays have successfully used sound to evoke 'place' while light focuses on 'atmosphere' and guiding audience focus. Many contemporary lighting and sound designers collaborate closely. This can mean talking together about how and when sound and light will change onstage as well as what each design will be trying to do at any given moment.

Storyboard

A storyboard is a frequently used tool in the worlds of film and animation for planning and

communicating visual ideas. Throughout this discussion, keep this in mind – it can be a useful tool for communication. For shows with lots of scenes and several large movable elements of set, storyboarding by the set designer and/or the production team is almost essential, to plan and show how each different scene will be achieved onstage.

Generally an LD's storyboard won't need to be that detailed, however. Don't be put off using this potentially valuable tool because you can't draw. Although some storyboards are aesthetically engaging, and some have been exhibited, that is not their primary purpose, and there are many digital and other alternatives to the traditional hand-drawn storyboard.

Many LDs find rough sketching in the rehearsal room to be very useful. Figure 2 shows some from LD Joshua Gadsby.

At its simplest an LD's storyboard is a series of sketch representations of the stage at different moments through the production. Josh also notes lighting design ideas on his rehearsal storyboards. They can be drawn by hand, but you might also experiment with rendering a 3D model of the set on a computer, taking photographs of the lit model box, or hand-drawing over photocopies of the ground plan.

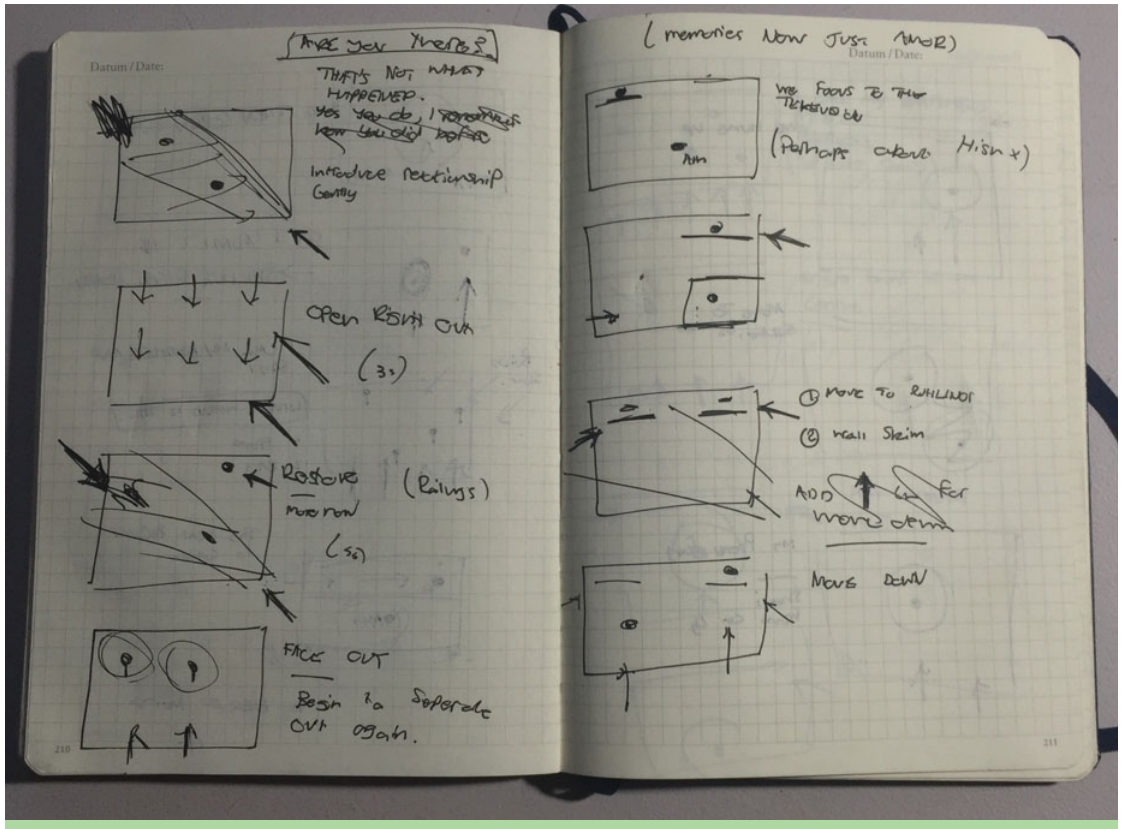


Figure 2 A simple sketch storyboard from LD Joshua Gadsby; a way of recording blocking and ideas generated while watching rehearsals and talking to his collaborators on the production.

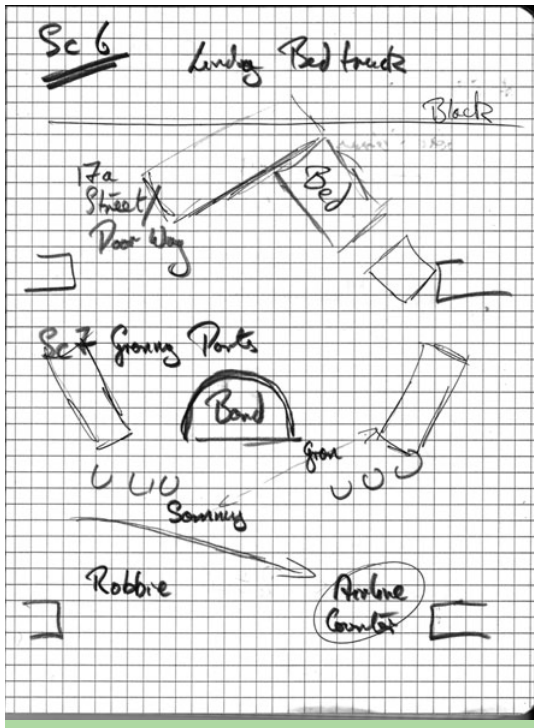


Figure 3 Sketching onto a very rough ground plan in the rehearsal room can be a useful way of noting what is where onstage for each scene. I find that using squared paper helps me keep things close to scale and in more or less the right place onstage. Arrows indicate important moves of people (or trucks). Leaving plenty of space allows me to add further notes at subsequent run-throughs.

These very rough sketches record just enough detail without taking up too much of my time and attention in the rehearsal room, so I can mostly focus on what is happening and what is being said, and contribute to discussions.

Using the model box to make a storyboard

It can be quite hard to reproduce accurate stage lighting at the usual model-box scale of 1:25, but it is usually worth making the effort. All too often the model box is illuminated by a single desk work-light. The impression gained from a model box illuminated in this way can be quite different from the eventual realized outcome onstage. Careful positioning of sources, including perhaps small torches or even individual LEDs for highlights, can produce much more effective lighting of the model. Ask if the model can be made with holes at the side to allow various angels of side-lighting to be introduced. Model boxes for proscenium spaces can be made much easier to light effectively if there is access from the sides.

Try to use sources with a similar colour temperature to the lanterns that will eventually shine on the finished set – these are more likely to be found in task-light with small low-voltage lamps.

A small torch with a tungsten-halogen bulb can be a good way to find out how particular colours will work with the set, and how different colours of light might work together. Focusable white light LED torches are similar enough in colour temperature to some moving lights to indicate how they might look onstage too.

Try to ensure that the box has figures, with some facial detail, in suitable places too. This will usually produce much more satisfactory images, which will be more useful to director and designers alike.

For more subtle lighting effects, you can use fixtures designed for shop windows and other display purposes while coloured light can be added using Birdies (also known as PAR 16s). Many larger theatre organizations and specialist performance design schools have a model lighting studio with small-scale specialist lanterns. This kind of facility can be useful for trying out effects and for taking photographs.

The lit model box should be viewed from similar angles to those from which the audience will eventually see the realized lit stage. It is of limited use to view the model box from above unless this is how the audience will see the space. As well as giving the director and the design team some idea about the evolving world that will be created for the performance, viewing

Figures 4a and 4b The model box for *Sweeney Todd*, designed and built by Keith Orton. The picture on the right shows how the box can be lit with a couple of task lamps. Both photographs have a blue cast – the camera was set for tungsten, but there was a lot of daylight in the room too.

Figure 4c The same model box lit in a model lighting studio to illustrate three separated areas. The colour is rendered better here too, because daylight has been excluded.

the model box from the same perspective as the audience offers an opportunity to investigate what each section of an audience will or will not see. This in turn may well inform decisions about blocking and masking arrangements and which lighting positions can be used – all information which will usually be key to the way the lighting design can evolve.

Theatre masking

Masking refers to materials that hide potentially distracting elements of production infrastructure from the view of the audience and help to create a frame for the stage picture. It is also used to provide a hidden 'offstage' place from which performers can enter, and set elements for other scenes can be hidden.

Masking at the sides of the performance space is often referred to as 'legs' or 'wings' (generally tall flats or curtains/drapes). Masking pieces above a performance space are usually referred to as 'borders' and are often used to hide the lighting equipment from the audience.

Masking can be 'hard' flats or 'soft' drapes and can be general purpose black or specially designed as part of the overall look of the production design. Positioning masking can have a significant impact on what each lantern can do and on the overall effectiveness of the lighting design.

No LD, especially when working on a proscenium stage, would want to be excluded from any discussion about the position of masking.

Working with the set and costume designer(s) and the director in the model box can be a very effective way to evolve truly integrated design solutions at a point in the production process when major changes to structures can still be made. Discovering, for example, that some small changes to the position or construction of a large set element will allow light from a new angle to highlight a strong performer location on the stage can be an exciting advance in the creation of the final performance. If it is made in the model box before that set element has been constructed and positioned, valuable time and money can be saved.

Generally, the more accurate the model is the more useful it will be. For example, if texture is reproduced accurately at scale and illuminated in a way that is achievable on the full-size stage, then its impact in 'show conditions' can be properly assessed. If this does not happen, if for example instead of correctly scaling down the ridges of a corrugated roof or the roughness of a brick wall, or a textured floor is lit from an angle that will not be achievable 'onstage', expectations are raised that cannot be met, and everyone is likely to be disappointed.

Using a storyboard

The rough hand-drawn storyboards shown here are simply tools that help the LD remember where people and things are onstage, and to evolve the rig. They would not normally be formally shared with the rest of the creative team, though there are times when this can be useful. In any case, these rough sketches are a useful aide-mémoire for the LD in their essential creative discussions with the director and other creative team members.

More photo-realistic storyboards or individual renders – whether based on photographs of the lit model box or computer renders of a digital model – will look more like a finished image of what might be the lit stage. This in itself can become problematic. Inevitably the visual representation produced by only one department will contain information that implies choices made by the others. The closer representation is to reality the more those other departments are likely to focus on what they don't like about the bits of the world of performance that are 'theirs' rather than anything positive. For example, if the

set design team present a render it will be lit in some way, and should have performers placed in the space. However, the light may not be what the LD wants or can achieve and the placement of the performers may not be what either director or choreographer want either.

Some directors shy away from the formally planned approach implied by storyboarding (and to some, by the model box too). However, when the production's situation or the working methods make storyboarding scene useful, it can also be very useful for the LD towards both a cue synopsis and a rig plan.

If you really can't draw

Many successful LDs say they can't draw. Often what they mean is that compared to their ability to make pictures in living three-dimensional space onstage, their ability on the two-dimensional page is disappointing. I advise young LDs to practise drawing and to find the media that they are most comfortable with, but many practitioners need other ways to record and develop their design ideas. One useful method is to sketch out in words the 'story of the light of the performance'. Leading LD Paule Constable reads the script, and the book if that is what the script is based on, and any other source material, and creates in writing a description of the light at each key point in the performance. This might be 'the Mediterranean sunlight streaming in through the window' (Don Carlos by Friedrich Schiller) or 'this man lives in a room with no daylight' (*Krapp's Last Tape* by Samuel Beckett).[3] These descriptions become more detailed as the production evolves through rehearsal and becomes the basis for developing a detailed cue synopsis, rig plan and lighting design.

Whatever method is used, it is important for the LD to invest the time and intellectual effort to produce communicable ideas for the light at each key moment of performance, and to discuss these ideas with the other members of the creative team.

Towards a cue synopsis

Using the lighting score or something like it, and/or a storyboard, the LD can record ideas and requirements for each lighting scene. As they work through the whole piece, recurring themes will often emerge and a rhythm too, which hopefully the lighting can work with. For example:

- In multi-location drama, the rhythm of interior and exterior scenes is rarely accidental – from reading or listening to the piece and in discussion with the director and other members of the creative team, underlying themes may be played here. On a relatively open set, there are usually many possibilities for light (and sound) to work with these themes.
- Looking at how the tempo varies through a piece may inspire an idea that can link dramatic tempo to intensity or colour choice at each moment. The changing tempo of the piece will usually inform the speed of transition – that is cue-times.
- A particular feeling or emotional state may build over a scene, an act or the whole piece. It may be appropriate to vary a particular lighting angle or colour in response to this.

Sometimes one or more key images will begin to crystallize in the mind of the LD – perhaps a dramatic sunrise building through the final act (e.g. the opera *Tosca*) or an architectural curtain of light sculpting the space of performance for a

[3] Both these examples were quoted by Paule in an informal talk on the set of *Coram Boy* at the National Theatre.

particular purpose. Practical considerations, such as light for entrances or faces, also emerge, perhaps as secondary to the main image, but hopefully as an integral part of it.

Light and signs

If we take the semiotic approach to performance outlined in Chapter 1, we can think in terms of the signs and signifiers available that will help communication with the audience. Hopefully a close reading of the text and discussions with the rest of the creative team will have revealed a range of things that it will be useful to signify at different moments. The creative team (hopefully led by a rigorous and informed LD) need to agree the signifying roles of lighting in each moment and through the piece. These may include:

- Different locations – in the multi-location drama, is there a particular colour or quality or physical arrangement of light that might signify each different location?
- Different times – when there is a need to signify different times of day, could long shadows from low-angled light signify dawn or dusk? Would a colour change work more effectively? How about both?
- Events such as a storm or a fire – which may be happening onstage or somewhere offstage.
- Emotional or psychological states – can a colour, quality or angle of light be used as a signifier? Blue light for 'the blues' and pink for a love song? Steep angles in psychologically tense moments? 'Broken beams' causing performers to move in and out of light as they cross the stage as a signifier of loss, or deception?
- Different levels of reality such as dream -states and natural states – could a distinctive colour palette or unnatural angle help with signification here?

There will also be things that need to be signified through the whole piece, not least the genre of the performance. This might come down to comedy = bright or musical theatre = colourful. There may also be signs that need to build in significance through the piece (growing foreboding, increasing despair).

Natural signs: the signs of nature

How might the performance lighting signify events in nature? Flashes of 'lightning' for a storm, a flickering red or amber glow for a fire? Soft-focused gobos for light through trees, a crisp projection of a photographically accurate moon? At many points in discussions of this type, the LD will need to decide to what extent it is right in this production to imitate the light of nature. To achieve 'natural' light onstage the LD will need to have made a close study of light in nature, perhaps using an extensive collection of photographs as a reminder, but essentially relying on their own observation of light in nature. For some productions, it might make more sense to adopt a more stylized approach – often following the language of the text or the design of the set or the style of the direction and performance. Whether the design choice is an attempt at reproducing the light of nature or something else, a consistent approach will usually help the audience decode the signs offered while working against other systems of signification onstage will confuse the reading.

Framing and focus

Performance lighting will usually define which parts of the stage are seen and which hidden.

What will be the signification generated by these choices? It will usually set both frame and focus of attention for the audience, both actions pregnant with the possibilities of signification since they are able in large part to establish the mode of audience reception. Take a production of *Hamlet* with a naturalistic set representing a castle – and the famous 'To be, or not to be . . .' soliloquy. Consider the signification of each of these lighting set-ups:

1 Hamlet in the castle, lit for night-time – no overt change in the lighting for the famous soliloquy.

2 Hamlet in his own 'lighting special' which appears for the speech. The castle still visible, but this time as background rather than the place where he stands.

3 At the beginning of the speech, Hamlet is suddenly in a follow-spot on an otherwise dark stage.

The first example would normally be read as naturalism – Hamlet wandering around the space where he lives, his contemplation part of the general world of the play. The audience is hearing the words because the character Hamlet is speaking them out loud in that world. The second choice is perhaps signifying that what we hear is going on in Hamlet's head rather than being spoken out loud by the character – that we are seeing an inner monologue that could not be heard by any other inhabitant of Elsinore Castle.

The last example breaks the conventions used in most productions of Shakespeare in the UK by introducing an overt sign usually associated with other genres of performance – the follow-spot. It could be so disruptive for a traditional audience that their attention is focused on the follow-spot rather than the words and meaning of the text as delivered by the actor. For an audience more used to concerts than plays, the follow-spot signifies a 'solo', a section that requires more attention, and this could work to enhance communication between stage and audience.

Concert lighting and signification

Live rock and pop music concerts are not often subject to this sort of analysis, but let's try. This time imagine a concert by a band with a charismatic lead singer who likes to get the audience up and on their feet at the beginning of the show. How can the LD help? There are two issues. First, signalling to the audience that they have permission to 'join in' the performance and get on their feet to dance and sing. Second, to enable the singer to see this activated audience – bearing in mind that they will usually have at least two bright follow-spots pointing at them from the moment they walk out. In most medium-sized concert lighting rigs the LD has at least two tools to play with: moving lights with beams that can be swung into the audience and 'audience blinders' – usually several clusters of units able to throw bright light into a large part of the auditorium. The audience blinders are usually there specifically to allow the artist to see the audience, to build up their energy by responding to that of the audience. But if these are used too early they will tend to reinforce the 'us/them' stage set-up by emphasizing the division between 'stage' and 'not stage'. The audience will tend to remain passive observers back in their seats. The moving lights can be made to break down this division, by sliding beams from stage to auditorium and back, by creating a look that unifies the singer with the (front rows) of the crowd. Whereas lighting the audience space as separate from the stage reinforces the difference between the two, creating a single space for lead singer and the front section of the audience gives further

permission to an active section of the audience to join in with the performance – and the singer can see them joining in and feeds off that.

Making this happen depends much more on the charisma of the lead singer and their ability to 'work the crowd' than on the concert LD. For the LD, getting it right means understanding the needs of both lead singer and audience, understanding how each will (subconsciously) read your work, and of course having the technical competence to make it all happen. And it has to be said that if the LD does not get it right, the singer is not as likely to get the audience on their feet, and therefore not as likely to have a 'good gig' – with all the potential consequences that can bring.

Framing and audience engagement

Very often, in live music concerts, on the drama stage, and elsewhere, the LD is responsible for determining to a large degree the way the audience engage with the show – and this is clearly important. Will the performance area be kept defined and separate from the audience area, as is common in most proscenium theatres, or will one part of the audience be at times the backdrop to the performance for another part of the audience, as can happen in a traverse configuration? Will the audience see the show from a very dark auditorium, creating a quite isolated feeling, or will they remain in a semi-lit auditorium, more aware of each other's presence and perhaps less intensely focused on the stage? These choices are clearly not the sole decision of the LD but light will influence how well they are received.

Framing can be thought about as the key to a large-scale structure of a performance, and as such considerations of framing will clearly inform the lighting design. How will the performance space be presented to the audience at key moments of the piece? Questions need to be asked too about what kind of world is being presented to the audience: are we in a particular place at a particular time, or are we in a more generalized world, or perhaps inside someone's head? Is the world of the performance the same throughout the piece, or does it change? How will the audience 'get' this? (In other words, what signifiers will be used?) A consideration of framing also asks questions about how the audience look at the performance: Are the audience to be passive observers of a dramatized but essentially objective re-presentation of events which have a history outside the script, or perhaps we want the audience to become partisan, supporting one of two or more contradictory views of an event presented or talked about on stage, or perhaps what happens on stage has no direct relation to the reality of everyday life?

To look at this in another way, will the production tend towards a Brechtian approach, continually reminding the audience they are watching 'theatre' not 'real life', or an approach based on Stanislavski, where the actors will immerse themselves in the role and present 'verisimilitude underpinned by psychological truth' to the audience?[4] Most designers working in performance would agree that the answers to these (and other) framing questions will influence their work on the piece. An established practitioner is likely already to be aware of the implications on design elements of any framing choices, and especially any decision to follow (if only vaguely) the theory and practice of particular practitioners. Aspiring theatre designers should have at least a basic understanding of

[4] Brecht, Stanislavski and others continue to have a huge influence on performance. Anyone wishing to work creatively in theatre needs to be familiar with their key ideas.

influential theatre makers such as Berthold Brecht, Katie Mitchell and Peter Brook.

Initial cue synopsis

The cue synopsis is often the most important document for the LD. It outlines how each lighting state is constructed, links each state to a particular piece of action and place in the script or music, and details how we get into and out of each state.

Whether the first cue synopsis comes before the thinking about signification[5] and framing, or after, or at the same time is a matter of personal preference and probably changes from project to project. Many LDs working in text-based drama make notes in the script as their first cue synopsis. Most will usually end up with a document in a table something like Table 1 below. Note the large amount of specialist 'shorthand' used.

Table 1 Cue synopsis for the beginning of the melodrama

Cue No[6]	Position/cue line	Timing	Purpose	Notes
	Preset[7]		Tab[8] Warmers[9] & House Lights[10]	Working light[11] US[12]?
	House Out[13]	12/12[14]	House & tab warmers out. Preset for Act 1 behind Tabs	Loose US working light
	Tabs Up[15]	8/8	Scene 1 – evening interior[16]	Practical?[17] Fire?[18] No FoH[19]
	Tabs ¾ Out[20]	5/5	Add FoH – warm	**Visual Cue**[21]

[5] Whether we are talking about signification of a time and place on stage or merely noting what the stage directions state, designed performance signifies and performance designers make choices about what to signify and how. The terminology of semiotics may not be used, but what is being thought about and talked about is essentially establishing the system of signs that will be used on the project. The words may be different but what is happening is the same.

[6] Cue numbers will not be defined until much later, but we usually include the column for reference.

[7] Preset is a common theatre term for anything put in place in readiness. Here it refers to the lighting state the audience will see as they walk in.

[8] Tabs is shorthand for the main stage curtain (also called front of house curtain) on a proscenium stage – this is what the audience normally see when they walk into a playhouse.

[9] Tab warmers are lanterns focused on the tabs, to add interest and focus audience attention.

[10] House lights light up the auditorium for the audience. They may be controlled from the main lighting desk or by a separate system.

[11] Working light is any light provided for people to do a job, such as setting up the scene, or checking props and furniture are all in place. At this stage we don't know if it will be needed, but experience tells us to include it here as a reminder.

[12] US in this context is short for upstage (i.e. the area behind the house tabs).

[13] House out is one way a DSM (deputy stage manager) or show-caller asks for the lights in the auditorium to be dimmed ready to begin the show.

[14] Time is usually in seconds, and at this stage is a guess, perhaps based on reading the script, talking to the director and designer, and experience. A standard notation is to write up time/down time (in this case both 12 seconds).

[15] This cue will 'Go' at the same time the DSM or show-caller gives the command for the house tabs to be raised.

[16] This brief description is likely to have come from the stage directions in the script.

[17] The practical in this case is probably a practical light fitting. As it is evening, it may be mentioned in the script or just assumed, or the set designer might have discussed putting a 'practical' reading lamp or suspending a fitting as if it were hanging from an unseen ceiling. At this stage it is a reminder that we will need to find out more.

[18] May be mentioned in the script, or merely implied – in either case this will need to be discussed with set designer and director.

[19] A reminder that, since the tabs will still be part way in, we do not want any lanterns in the auditorium to be on.

[20] When the house tabs have 'cleared' they are sufficiently out of the way for the front of house lanterns to be used without ugly beams striking the tabs.

[21] Means the lighting operator will 'take the cue' using their own judgement of the best time to hit the 'Go' button, rather than waiting for the DSM or show-caller to say 'Go'.

A quick note on time in cues

Generally, cue time is the time between the 'Go' at the start of the cue, and the completion of the cue, when the new lighting state is established on stage.

We don't need to use the same time for every change involved in establishing the new cue state. If we are just dealing with intensity, we can 'split' the time for a cue and have a different up time and down time. 'Up time' refers to the time taken for intensity to build – generally associated with the new cue state developing on stage – and 'down time' is the time it takes for the intensity of units reducing in intensity to 'fade'. These will be units not required in the new scene (if they are fading to zero intensity) or required at a lower intensity than in the previous cue state.

For example, if we wished to shift the focus of audience attention from an area downstage left (DSL) to one downstage right (DSR), we could use a cue that increases the intensity of the lanterns focused DSR and reduces the intensity of those focused DSL. Often this kind of cue works best if the new area of audience focus establishes quite quickly while the old area returns to a 'background' intensity more slowly – so that this is almost unnoticed by the audience. (After all we want them to be looking at the new area of focus, and we know that our attention is drawn towards rapid changes in intensity – increases or decreases.) The cue might use an up time of say 3 seconds, and a down time of, say, 12 or 15 seconds, which would mean the units focused DSR would increase in intensity to their new levels in three seconds, while the units focused DSL would reduce in intensity over 12 or 15 seconds. This is called a 'split time' fade, and is very useful in all kinds of situations.

But what if action in the old area continues for a line or two after the need to establish the new area? Even with a slow fade we could find performers in the old area only dimly lit for an important line at the end of their scene. Well we can delay the start of the down fade, using what most lighting desks refer to as a 'delay time'. In this case we might have a cue with a delay of say 6 seconds, so the down fade, i.e. the reduction in intensity of the units focused DSL, would not begin until 6 seconds after the 'Go', which initiated the up fade of the units focused DSR.

We will come back to cue times later in the book.

Table 2 Melodrama cue synopsis

Cue No	Position/cue line	Timing	Purpose	Notes
	Act 1 scene 1 Entrance of Dad	12/12	Raise level round Dad's chair ready for . . . Dad sits	
	Dad begins ghost story	60s? maybe much longer	Slow partial close down – create atmosphere for story telling – move away from 'normal' look	Highlight Dad: moonlight through window SL or from fire light SR?
	When the story turns nasty? (somewhere near first death?)	30s	Heighten supernatural atmosphere further. Big shadows on US wall?	Birdies on DS edge? dim red wash over walls? (from fire?)
	Just before end of story	To complete on last word	Rapid close down to Dad & Chair and big shadow	
	'but it's only a story'	6/3 wait 3	Restore to close to opening look	Keep red from fire? or the Birdies from DS

What we have here is an outline of the role of lighting at the beginning of the play. This early cue synopsis is as much a document for discussion as anything else since at this stage many things are a guess. For example, it may not even have been decided whether to use tabs yet. Even if this decision has been made, how fast they should go out will not usually be decided until the technical rehearsal.

Let's imagine we are working on a two act play with a single interior setting, a melodrama with a relatively straightforward dramatic structure, and scenes in the daytime and at night. Later on in this book we will see what that set might took like, but at this point let's imagine we just have the script.

Having read that a couple of times we know that the plot of Act 1 involves a character called The Father telling a ghost story. At that point in the script the cue synopsis might look something like Table 2.

The idea here is that we begin with a 'normal' look when the Father comes in, and very soon begins to tell a ghost story. The lighting will begin by helping to establish the 'normalness' of the opening of the scene. It will then help to direct audience focus onto the Father in his chair, retaining the 'normal' look. As the Father begins to tell his ghost story, we slowly change the look from 'normal' to 'supernatural'. Exactly how we will do this is yet to be decided, but we have a few ideas – we might try to hint that the Father is lit by a beam of moonlight coming through the nearby window, or from the flickering light of the fire. Again – at this stage we have yet to define how either of these 'signs' would be realized, or which sign would be most appropriate to also signify something about say the Father's character, or the amount of credence the audience should give to his story. As the story becomes 'nasty', we want to further enhance the supernatural atmosphere, and the idea of over life-sized shadows on the upstage wall is mentioned. Our ghost story has a big ending, and we want a lighting cue to enhance that. In placing this cue, what will be important is when it ends, not when it starts, hence the note in the cue synopsis: 'To complete on last word'. After this dramatic ending, we require a restore to 'normal' but perhaps with a hint of 'supernatural' left in too – hence the note to 'Keep red from fire? or the Birdies from DS'. As the production develops through rehearsals, with luck the director and LD will be able to talk through these ideas and make some choices: will the sign of 'supernatural' be moonlight or flickering firelight? The choice here may well revolve around does 'warm' firelight look better in the scene than 'cool' moonlight – but discussions might also take in motifs from later in the play: If the denouement involves fire, can the 'firelight' be a precursor? If the Father is eventually revealed as the villain, can we hint at this by what we reveal of him in the 'moonlight'? (Gaunt features and the pale skin of one who avoids sunlight?)

Don't work in isolation!

There is little point evolving a complex system of lighting signs in isolation from the rest of the creative team. Performance lighting cannot successfully be developed in isolation from the rest of the makers of signification and spectacle working on the production – director, other designers working on the set, costume, sound, projection, the choreographer if there is dance involved, and the writer if the script is still evolving. The performers will normally be carrying the main burden of signification, and the production lighting team will turn the dreams of the LD into a reality. All these people and more will have valuable contributions that impact on the evolution of

the lighting design. Making performance is about collaboration, and anyone who forgets this important fact is in trouble.

Watching rehearsals

Watching the performers develop the performance in rehearsal is often the best place to develop ideas and make choices about the lighting design. If the space chosen is suitable, the director will usually want to experiment with the relative positions of performers, and how they will move in the performance space. This is known as blocking. It is important for the LD who wants to produce more than blanket illumination to know where each performer will be and what direction they will be looking at each moment of the performance.[22] There are several ways of noting blocking. Perhaps the most common is to make sketch copies of the main features of the performance space and draw annotated arrows indicating movement, such as those in Figures 1 and 2 earlier in this chapter. Each sketch needs to be linked to a particular scene or part of a scene in the performance – and this is another time when the lighting score is handy. It is best to work in pencil, since blocking is rarely completely worked out even by the technical rehearsal. Many genres of theatre performance rehearse with a member of the stage-management team in the room. One of the primary functions of this person will often be to note blocking, and keep a record of changes. Among other things, this enables the stage-management team to introduce an understudy in the absence of the director. If the LD establishes good relations with the stage managers (a must for almost all theatre-based work) they can arrange to be kept informed of significant changes that happen in their absence. Despite this, many LDs find it invaluable to take their own blocking notes in rehearsals.

But an LD can learn much more than where each performer will stand by attending rehearsals: How is the piece developing? Are new themes emerging? Are initial assumptions from the LD's own text analysis being challenged by the performers as they evolve their characters? Are sections of the text being cut or new sections being added? At what pace are different sections being taken? More directly: Has the set design changed? Have the colours of the costumes changed? Don't assume that someone would tell the LD if that happened. Many people who work in the rehearsal room – and this can unfortunately include directors and even some other designers – have little or no understanding of how changes to set and costume or sound impact on lighting design. Another shock the aspiring LD may get in the rehearsal room is how often the director might say 'Don't worry about that, we will leave it to lighting to sort out!' Again, the LD cannot assume that someone will let them know about the new or changed expectations of those in the rehearsal room. The only solution is to be there as much as possible, especially once the production 'gets on its feet' a term for the later stages of rehearsal when the performers have learned the script and begin to move around the space in the manner of their character.

Watching rehearsals is usually very educational for non-performers, and can be great fun, but some rehearsal rooms are very tense and edgy places. When things are not going well, and sometimes even when they are, performers

[22] Many lighting designs start with the question, 'How do I get light into the eyes of whoever is key to the story?' Hence the need to know (and document) where the performers are and where they are facing.

The stage-management department

Professional stage management is a key part of UK and North American theatre. The roles of stage management that a theatre LD most regularly encounters are managing the rehearsal room and, onstage, 'calling' the show.

A stage-management department will usually be formed as follows:

Stage manager (the head of the department), often responsible for health and safety on stage and in the rehearsal room, usually quite senior in the company and works closely with the director. In larger organizations and on many tours the department is led by the company manager, who often also handles wages and per diem and many of the day-to-day duties of the production manager.

Deputy stage manager (DSM), not only no. 2 but also usually responsible for assembling 'the book' – an up-to-date copy of the script with all the cues for each department noted in it. During performances, the DSM will usually be the show-caller – also known as being 'on the book'. It is very important for the LD to build and maintain a good working relationship with the show-caller.

Assistant stage managers (ASMs) who may fulfil a variety of roles including preparing the stage or rehearsal space for each performance or rehearsal by setting props and furniture, buying and making small props, and assisting with performer quick-changes and costume maintenance when there is no wardrobe department. Some companies use ASMs as technical operators for sound, automation and sometimes lighting.

At least one member of the team (usually the DSM) will be in the rehearsal room for every rehearsal, taking notes for the director and cast. These will include cuts or additions to the script, blocking and other essential details that will all go towards making 'the book' (also known as the prompt copy). This person is usually responsible for sending out daily bulletins, known as rehearsal notes, to the rest of the company.

In performances by UK and North American theatre, dance and opera companies almost every cue in the show is 'called' by the show-caller from notes in 'the book'. The show-caller gives standbys to the technical operators and performers. For example, they might say, 'Standby lighting cue 6, sound cue 3, fly cue 4 and performers at the upstage entrance'. Each standby needs to be acknowledged by an operator (lighting sound and flys) or an ASM standing close to the performers (performers at the upstage entrance) The show-caller then gives the signal to go, by cue-light and voice: 'LX cue 6, go; sound 3 and flys 4, go; upstage performers, go.' The precise position of each 'go' is recorded in the script or score. This way of working enables more flexibility of staffing while maintaining a consistency of performance – though it can limit the potential for creative response by the operators.

When the show-caller says 'go', unless you can see you will kill someone, you go!

and director often behave in ways they would not behave in public. For many, the rehearsal room is like a laboratory where a performance can be built, but sometimes this involves behaving in an extreme way to get results. Aspiring makers of performance need to understand the potential vulnerability of performers, and to respect the rehearsal room as their workplace. There may be times when you are asked to leave a rehearsal, or to limit your attendance. It is in these situations

that your relationship with the stage-management team becomes even more important. Most professional stage-management teams produce rehearsal notes on a regular basis. These can be a very useful link to what is going on in the rehearsal room. With the prevalence of email, there is little excuse for an LD not getting rehearsal notes, and even less excuse for, having got them, not reading them. Rehearsal notes are usually broken down into sections for each department. It is a good idea to read everything rather than just the notes in the 'lighting' section – not everyone in the rehearsal room is conscious of the impact of changes across departments. It's also a good idea to question anything you are not sure of in the rehearsal notes.

Working with performers

Most genres of performance rehearse the performers in a different space to the one they will end up performing in. This is usually down to economics. If the venue is being used as a rehearsal space it usually cannot be making money as a performance space. In this country there is very little tradition of taking performance lighting into the rehearsal space except in the live concert sector, where the practice is very common. In my view, the failure to make performance lighting available in the rehearsal room has limited the creative contribution of LDs to making live performance, and led to a generally poor understanding among theatre directors, actors and set designers of the potential of performance lighting. Perhaps a new generation of lighting practitioners can be bolder in taking the tools of their trade into the rehearsal room so that, in the later stages of the evolution of a performance, the potential of light in performance can be fully explored.[23]

When a director needs a performer to do something they are not used to, the director needs to gain the trust of the performer. It is the same for a LD, though without the advantage of the natural hierarchy of relationships that exists between director and performer. If a particular lighting state relies for its effectiveness on the actions of a performer, then the LD will usually need to work with the director and the performer to ensure that the effect happens. Let's go back to the Father telling his ghost story. If we want to make the most of the shadow play on the wall, we will need the actor playing the Father to work with the effect, perhaps leaning into the light at key moments to increase the size of his shadow, or turning his head to show only a profile at certain points. By engaging the director and the performer in the project, showing them how small changes in performance can enhance or diminish the effect, all these things are possible – but they will not happen without the LD's active engagement (at least not reliably). Different productions will require the LD to accomplish these types of negotiation in different ways. At times it will be possible and appropriate to appeal directly to performer – 'Do this here and we can make you look great!' At times the negotiation will be harder, and sometimes the LD loses. Some good advice I had as an aspiring LD was to stand in the place you want the actor to be and see what it feels like for yourself. This helps the LD to explain to the actor what they should experience when the effect is working, and allows the actor to see what they look like in the right

[23] This practice would not be as 'new' as perhaps it sounds. Many theatre traditions protected from the commercial and other pressures of North American and British theatre are able to spend more than their last rehearsals in the performance space 'under lights'.

place – and in the 'wrong' place. It also allows the LD to experience any discomfort involved, and perhaps be able to temper that to the benefit of everyone involved.

Moving towards realization

Once the company have begun to put the production 'on its feet' – and often some time before that – the production manager, chief electrician or the production electrician will be asking for some details about the lighting rig the LD intends to use. Certainly the LD should be informing whoever will be responsible for the installation of the lighting rig of any special requirements, even if only for costing purposes. It is good practice for the LD to keep everyone who needs to know informed as lighting design ideas evolve. There is frequently competition for hanging space above the stage and elsewhere, and the LD needs to make sure that their needs are not forgotten when decisions are made about what will hang where. A successful LD will establish ways of keeping themselves informed of changes in other areas of the production; changes to anything from the way the set is being built (which might, for example, change the way practical fixtures can be attached to it, or restrict access to potential lighting positions) to the colour of the costume, to the schedule of the fit-up, to the position of speakers and microphones to the choice of images to be projected. Any of these could have an impact on what can and cannot be achieved by the LD.

The lighting design department will need an accurate ground plan and section of the performance space and the set, with enough information to determine where lanterns can and cannot be placed. In the next chapter we will look at approaches to deciding what equipment should go where, translating ideas about the 'feel' or 'atmosphere' required at each moment of the performance into a rig that will enable these effects to be realized.

One lighting design for the whole production

To close this chapter, I want to underline once more the need to have your lighting ideas on paper – as sketches in a storyboard, as computer renders, as treated photographs or as a written-out scenario for the motivation of the light at key moments in the performance.

A detailed cue synopsis is most often the best way to express your lighting ideas in readiness for making cues in the performance space. This document will continue to evolve with rehearsals, and be influenced by meetings with the director and the other designers. Most often, when you come to make your cues in the space, you will not have as much time as you would like, but if you have thought out ideas ready for each key moment, you will have a place to start discussion. The ideas may turn out to be perfect, or to be truly awful, or most likely something in between. However, especially when you are starting out as an LD, it is better to have something down on paper that will guide your first choice, and help you to get some light onstage to respond to than to begin lighting each new scene with nothing!

A dramaturgy of light

Dramaturgy can have several different meanings, but in this context, I'm mean *storytelling* – opening up the possibility for light to help *tell a story* onstage rather than just illuminate the action. The story light tells may not always be clear, and we need to be aware that most of the time light onstage is only one of many players,

but any aspiring LD working in live performance needs to be aware of the dramaturgical potential of light onstage. Literary dramaturgy implies a kind of consistency of approach through a piece, and for light to work its dramaturgical magic, the lighting design needs a unity to it too.

Doing the work to come up with a detailed cue synopsis – however it is arrived at – can help us think about the show as a whole, rather than as a set of discrete parts. To work for the design it has to make it more likely that you can realize a lighting design for the whole show, rather than a series of individual designs for each scene or song or act. This is important for a number of reasons.

Unity in design has an aesthetic appeal to most audiences, and unthinkingly disrupting that unity can result in the audience losing their focus. They may not name a lack of a consistent approach to the lighting design as the cause, but it often is. This disruption might be an unmotivated change to the colour palette, the direction of the main keys or the overall quality of light onstage. The thing to focus on here is 'unmotivated' since any of these things in the right place can be powerful signifiers or metaphors.

Establishing any language requires a consistent approach, particularly when some of the signifiers are arbitrary signs. If you want the audience to 'get', say, warm light as inside and cool light as outside, or light from steep angles as tension, or long shadows as menace, you have to work at it and be consistent. For example, there is no point doing warm interiors for most of the show then expecting the audience to understand that the next warm scene is not inside at all.

There may be times when you want to disrupt the aesthetic unity of the spectacle, for a good reason, which is a very different situation. The decision to do this – at least for an LD at the start of their career – is likely to have been informed by a detailed, well-researched analysis of the piece and close observation of the rehearsal process.[24] There may also be times where it is useful or appropriate to undermine a particular set or signifiers you have previously set up, for a good dramaturgically consistent reason. But again, this is likely to be motivated by close reading of the text and close collaboration among the creative team.

However, most of the time it is useful and most effective to develop a unified approach to your lighting design for a production, developing what we might call a consistent dramaturgy of light.

[24] A more established LD may make a choice like this based on 'instinct' – but if that choice is going to work it needs to be made with a deep understanding based on a lot of experience of how performance works.

6

From concept to lighting plan

Stage 3: planning the rig

What kind of light do you want where?

Having followed the process outlined in the last two chapters the LD by now should have some idea about the kind of light they want at key moments of the production. This may not be totally worked out – almost every lighting design evolves in the performance space with the real performers and the real set and costume – but it's a very good idea to have at least a skeleton in place.

Of course, other foundations need to be in place too. These will include a good understanding of how light works in performance spaces, and of what the equipment will do. If you are not familiar with the different types of lantern you have available and the effects they can produce on stage, you will not be able to make intelligent choices about what to use where.

Experienced LDs often say they work a lot by instinct. This instinct is built on years of experience of working with the equipment, perhaps as an electrician, an assistant designer, a programmer or an LD in their own right. A working LD needs an understanding of the kit their design will employ, and of colour, angle, glare, reflection and hundreds of other things that will inform their choices. If you have the chance to go into the space you will be working in and try out the equipment, this should not be missed. If you are a relative novice at lighting design, dipping in and out of this book, please make sure you have read Chapters 2 and 3 before continuing.

As ideas for a lighting rig develop, it is important to keep in mind the priorities of the production. In the opening chapter I wrote briefly about the need to provide visual acuity of the performer to the spectator; literally to allow the audience *keen sight* of the performers, to assist in enabling clear communication between performer and spectator. Even though it is likely that at some moments of performance, the creative team will decide that clear and unmediated communication between performer and audience is not the first priority of the lighting design, the role of the performance LD is most often to present the spectator with as much visual information as is appropriate at each moment of the performance. This is especially true in genres of performance where the spoken word is important, because as I mentioned in Chapter 1, it is harder to understand the speech of someone whose face we can't see well. For a LD working in drama, the first priority is usually making sure the faces of the performers are suitably lit; faces, not necessarily whole heads. The face forms only a small part of the head. And it is worth noting that even on a proscenium

Figure 1 A scene from *The Caucasian Chalk Circle* at the Royal Central School of Speech and Drama. The back wall of the open stage set is washed in deep blue from discharge lamped moving lights – evoking the rich splendour of the palace (about to be abandoned). A strong top-light wash reveals the form of the hanging costume, casting shadows of the 'wardrobe' of the escaping aristocrats on the stage floor behind the servants, who are lit separately – as the primary focus of this part of the scene. Meanwhile the heroine is seen escaping onstage left (with the unwanted baby) – lit in a cross-light special (see her shadow on the proscenium behind her) – while the Duchess (downstage right) has a three-quarter back-light from upstage left (see her shadow on the stage floor) as she watches over her servants. (Lighting design and photograph by Matt Daw.)

stage, in most drama productions the performers frequently face across or into the stage not out to the audience. Light for faces will need to come from wherever the performers are facing, so that might not be from out front.

When the focus of the performance is not the spoken word priorities will be different. Dance work needs the LD to direct attention to revealing the form of the body in space. Opera, especially at large scale, needs a design approach in harmony with the music. The LD for rock 'n' roll or live concerts is usually hired to provide a visual feast onstage – the faces are taken care of by follow-spots and image magnification.[1] Each genre of performance has a generalized set of priorities, but it is important to establish what is expected of lighting in each production you are working on before your design process gets too far.

[1] Image magnification, or IMAG, is when live cameras take pictures of the performing artists and these are shown on large screens. This is a very common technique for larger-scale music concerts and festivals.

A general cover and motivated light

It is often necessary to provide even washes of light over a stage or other performance area, to ensure good, distraction-free visibility, for example. This kind of light is usually referred to as a *general cover*, and it can be a good place to start when it comes to deciding which lighting fixtures will go where in your rig. A general cover approach will usually mean placing fixtures that work together to create a number of washes – one wash to a greater or lesser extent filling the shadows created by another. In many traditional theatres, the front-of-house hanging positions exist to make it easy to create the washes that provide a general cover, and the house crew will be able to advise a novice LD on how to make best use of these positions.

However, this is not the only possible approach to designing a lighting rig for theatre. Often we are presented with a stage set that includes some obvious place that the light in the stage world should be coming from. Perhaps it's a window or a skylight that will let in light from an imagined sun or moon. Perhaps it is one or more suspended light fittings, wall lights, a desk lamp or even a fireplace. Perhaps we are outside, and the stage will need to appear to be bathed in light from the sun or the moon. When this is the case, it gives us a clear *motivation* for the direction and quality of the light – for that scene or perhaps for the whole piece.

Thinking about the motivation for the sources – or at least the apparent sources – of light onstage brings us close to a key idea of Adolphe Appia's – *active light*. In his experiments at the Hellerau Festspielhaus in the early years of the twentieth century, Appia made a distinction between *passive* and *active* light. His passive or diffused light is generalized, what we might call *soft*. Casting little or no shadow, perhaps the light in a library, or in a white-walled space lit by several heavily diffused ceiling fixtures, or outside on a cloudy day when there are no distinct shadows. Appia's active light on the other hand, is *focused* or *shaping* light, that allows distinct shadows to be created. With these distinct shadows comes the perception of a direction from which the light is coming – which requires a motivation.

There is much more on Appia's work in Scott Palmer's excellent book *Light: Readings in Theatre Practice*.[2] What is important to note now is that the focused active light, shaping bodies and objects and casting distinct shadows, reveals its apparent origin. If that origin is consistent with other elements of our stage world, seen or unseen windows, lighting fixtures or a fire, then all is well. If, however, where the light appears to come from contradicts other elements of the stage world, then it may well distract at least some of the audience from what should be the centre of their attention onstage.

As we have said several times already, much of the time the job of light onstage includes selective illumination and the revelation of form. Much of the time, this implies focused light, creating distinct shadows and revealing its apparent source. So this means that when we take an approach that includes creating a general cover we need to think about how the apparent source of this light works with other elements of the performance. There is no reason why a general cover cannot be motivated light. On the other hand, if the way it reveals its source onstage contradicts other elements of the performance, it is likely to be unhelpful.

[2] Published in 2013 by Palgrave.

Washes, specials, keys and fill

What most people mean by a wash is the same quality of light over a relatively large area. In nature, this usually means sunlight or moonlight over all or part of the field of view. On most performance stages, most washes are achieved by blending together the output of several fixtures. This can be troublesome as it is often difficult to make the blending work without creating distraction caused by sharp changes in intensity as a performer moves from the light of one fixture to the next. When you get the blending right, however, creating a wash from several fixtures has advantages. For example, we can highlight smaller areas within the wash by selectively raising the intensity of one or more of the units. We can even use individual units in a wash on their own, as 'specials'.

What most lighting people mean by a lighting special is light used to draw attention to a smaller area of the stage – to *highlight* it. What makes the special stand out could be higher intensity but it might also be different colour, beam quality or angle of incidence. We might use specials to lead the attention of an audience in a musical number in which several different performers have solo lines for example. On a drama stage, we are likely to use specials more subtly, to guide the attention of the audience. Often a special is just one unit, but it doesn't have to be.

Key light and fill

Back in Chapter 2, I mentioned another way of talking about stage lighting – borrowed from lighting for camera. Key light is the term used to talk about the main light source in a camera shot. Light used to balance the key light is called fill light. On the stage, what we usually mean by key light is the light that provides the apparent main source of illumination for the subject or the space – an idea closely related to the idea of motivated light. In lighting for camera, we usually only have one key light (primarily to reduce the presence of distracting double shadows in close-up shots). Onstage, we often need several 'key lights'; as we have noted before, it is not usually possible to be quite so purist with light onstage as it is with light for the camera.

In some scenes from the melodrama mentioned in Chapter 5, we might start *keying* the scene from the window. As we imagine the daylight fading, we might lose the window key and move to keying the scene from the fireplace – imitating firelight. For the supernatural climax we want over-life-sized shadows on the wall, so the key would be from something low down and in front of the storyteller, perhaps a small fixture on the front edge of stage.

More generally, the key light for a lighting state (cue state) or scene might be a special, an element of a wash or the whole wash. The fill light is whatever we use to make visible anything hidden by the shadows of the key light. It could be other sources, carefully placed so as not to reduce the impact of the key light.

Figure 2 Strong key light on from behind the performer creates the dynamic shadow in front of him and highlights the edges of his body. His face is lit from a low angle, ensuring that no other shadow on the stage floor undermines this.

Scaled plan view and section drawings

A plan drawing is a scale drawing of the space viewed from above, with all vertical surfaces 'squashed' to lines. Just like a street map, it represents an idealized 'bird's eye' view of the area. Using the plan and a suitable scale rule, we should be able to find the dimensions of horizontal features such as lighting bars (pipes in North America) or set trucks, and the horizontal distance between various places in the building (when combined with vertical distance obtained from the section, see below, this is useful for calculating lamp throws and cable lengths for example).

Plan drawings are used extensively in architecture and engineering as well as by lighting and sound designers, set designers and set constructors, stage management and production management.

The plan view cannot be a full representation of any but the simplest space. For example, a ramp may be represented in plan view in the same way as a large table, a trap door or a flat rostrum. Most plans show the outline of structures at a particular level, typically just above floor level. The plan may not show overhanging features, such as water pipes or a technical gallery that may have an impact on, for example, the space available to suspend scenery or lighting equipment.

A section drawing is usually a view of the space from the side, down the centre line. To create a section drawing think of the space cut in two with a giant saw along a horizontal line! (in theatre this is often the centre line of the stage and auditorium). Next, imagine picking up one half of the building, inking the newly severed walls, floors, ceilings, etc., and making a print of it – just as children might make a potato print – then shrinking the paper down to scale! This kind of section has big limitations – anything that is not actually on the particular line of the section will not be on the drawing. To make the section more useful, details of any structures of significance, even if they do not cross the section line, are usually included in a different line type.

Important uses of the section drawing include showing relative heights of objects, determining what the audience can and can't see (called sightlines), helping in the calculation of beam angles and determining the position of 'top masking'. For the LD, the section is just as important as the plan. It is usual for the LD working on paper to produce several sections themselves, often using height information gathered at a site visit. These will be used to accurately determine the throw and required beam angle for lanterns from each position.

To some extent, computer-aided drawing packages have reduced the need to draw multiple sections. Providing the performance space has been accurately modelled in one of the digital drawing packages, any competent user of the better programmes can put themselves in a position to 'see' – in the virtual world – the effect of any lantern from any position. The user can try out different beam angles and see what impact they have on the size of the beam on stage, and what structures might get in the way of the beam. However, accurate modelling of a venue is time consuming and therefore costly and many working LDs prefer to sketch sections as they need them.

Sketching on a ground plan

The choices made by the LD relating to what kit goes where will be constrained by the availability of lanterns and other equipment and by the theatre architecture before any considerations of the needs of the production. So, before we can get much further with the design, we need accurate information about the space in which we are going to stage the production and about the kind of equipment we can use. Information about the space traditionally comes as a scale ground plan

and section. Information about the venue might be in the form of a 2D or 3D CAD[3] drawing, a digital visualization, a series of photographs or a virtual reality tour. What most LDs and every production lighting chief needs is an accurate ground plan and section showing the position of the set and all the available hanging positions. As a lighting practitioner, if you don't know anything else about CAD, it is a very good idea to know how to obtain a scaled plan and section from the most used drawing packages, including AutoCAD and Vector Works.[4]

The list of equipment that is available can be as definite as an inventory from the venue or, if the rig is to be hired, as vague as a figure in a budget. I will assume for the moment that, in addition to our detailed cue synopsis, we have accurate scale drawings of ground plan and section, and a reasonably extensive inventory of lighting equipment to draw on.

Putting the equipment in place on the plan is often the phase of the lighting design process LDs try to postpone as long as possible. Each decision seems so fixed and final, and usually has to be made at a time in the process when the piece is anything but fixed and final. Each decision made seems to remove more possibilities than it presents, but if you want to make bold statements with light whenever it is appropriate you must be bold in making choices. The better informed your choices, the more likely they are to be successful, so rigorous research into the piece, the space and the equipment, and detailed discussions with the director and the other designers need to inform each choice.

Building a list of what light needs to do

The lighting score, storyboard, written account or whatever has been used to produce the detailed cue synopsis will also have made clearer some

Reading a drawing: beyond the key

Like a map, a lighting plan is a representation of a larger three-dimensional space, on paper or on a computer screen. Just as a map uses symbols to represent each class of important feature (places of worship, hospitals, woods, etc.) so a plan uses symbols to represent important features of performance space and the lighting rig. On maps and stage plans, the key helps users read and understand what is being looked at. On lighting plans, the key should tell us which symbols represent each type of fixture used in the design, and may tell us the meaning of each line type used (dotted lines for this, solid lines in red for that, etc.). Usually the key is on the same piece of paper as the plan drawing, but even when it is there may well be signs and symbols used that the maker of the plan expects all users to understand. These common line types and symbols are often part of a set of national or international standards, used by professional drafts-persons throughout an industry sector (e.g. architecture) or across a geo-political area (e.g. the EU). One example is the combination of short and long dashes used for all centre lines.

If it is not clear to you what a line or symbol used on a plan represents, if possible ask the person who drew the original.

[3] CAD stands for computer-aided design, and is generally used as shorthand for anything drawn on a computer in whatever program. This includes AutoCAD, WYSIWYG, Vector Works and many others.
[4] That might be 'give the file to a friend to do it', but what will you do when that friend is not around?

of the choices to be made. It may not be clear, however, how these choices add up over the whole piece. With the help of a detailed cue synopsis and/or the lighting score it is possible to distil the generalized lighting requirements of each section of the piece into a unified 'wish-list' for the whole production. This can often be achieved in the first instance by drawing coloured

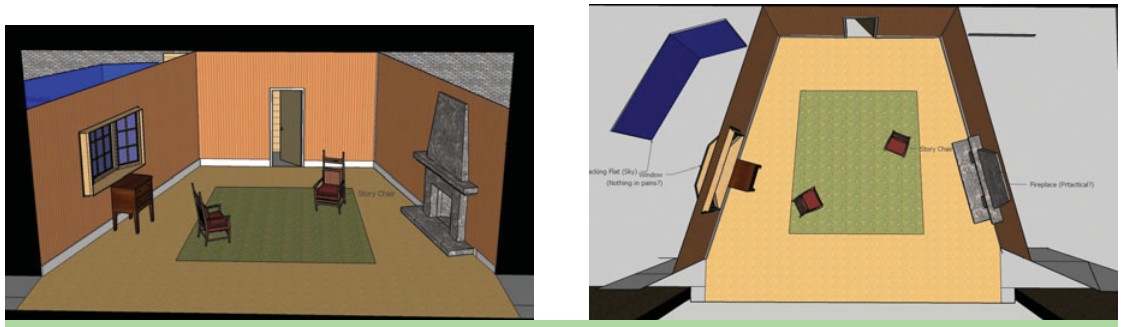
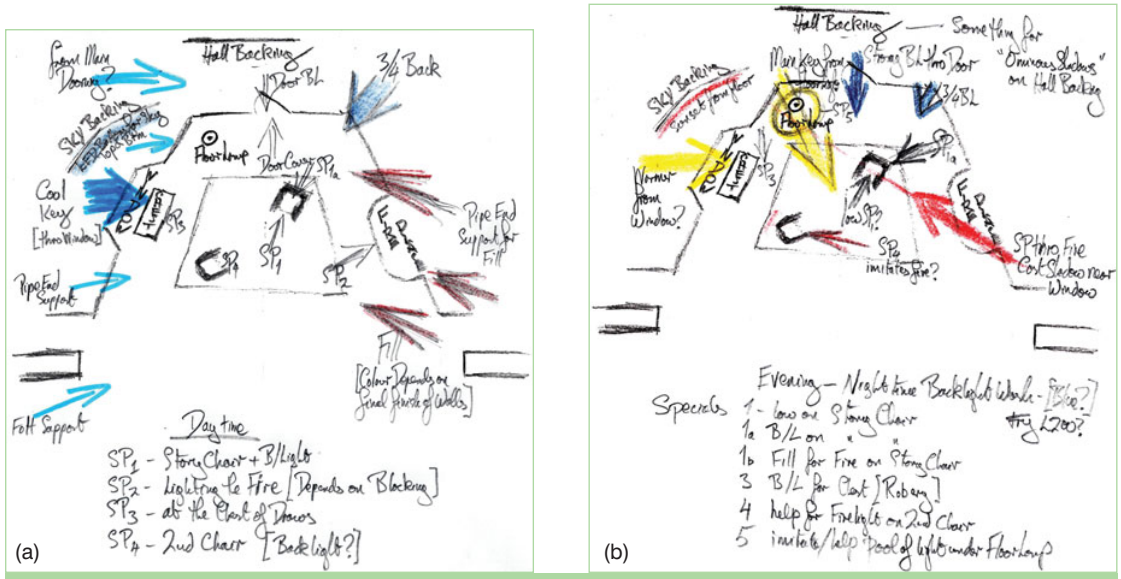


Figure 3 Two views of a SketchUp digital model of the set for our melodrama. Hopefully the set designer and LD have discussed things like positioning the backing flats to allow light to get through the window and door from an appropriate direction, and placing the story chair so that the light from the fire can cast a shadow on a wall. Notice that this version has no practical lights. The idea of adding a practical floor lamp (rather than, say, suspending a light fitting as if it were hanging from the ceiling or using wall lights) is a later addition. Using the floor lamp as the perceived source of light in the evening scenes gives us the option to make some parts of the room darker and – hopefully – mysterious or threatening.


Hall Backing
3/4 Back
Floor lamp
Cool Key
Pipe End Support for Fill
Fill
Daytime
SP1 - Story Chair + B/Light
SP2 - Light from the Fire [Depends on Blocking]
SP3 - at the Start of Visions
SP4 - 2nd Chair [Backlight?]
(a)
Hall Backing
Floor lamp
Evening – Night time Backlight
Specials
1 - low on Story Chair
1a B/L on "
1b Fill for Fire on Story Chair
3 B/L for Chat [Robert]
4 help for Firelight on 2nd Chair
5 invisible/help Pool of light under Floor Lamp
(b)

Figures 4a and 4b Getting a sense of what the rig will need to do – two sketches from early rehearsals of the melodrama. The colour here relates to warm/cool/neutral and thickness of the arrows to the maximum strength of light from that direction. Sketching ideas onto a rough ground plan is often a good way to start working out what fixtures to put where on your lighting plan.

4a records initial ideas for daytime scenes and 4b for night-time scenes.

arrows onto a ground plan. On p.125 are views of a SketchUp digital model of the set for the melodrama briefly mentioned in Chapter 5, followed by my rehearsal room sketches.

My sketches develop, often beginning right from the first discussions with the director and other designers. Once we have an agreed set design, and the actors start to move about in rehearsals, they often really take off. From these sketches, I can start to build a list outlining what I need from my rig. For the melodrama, it might look something like the following.

For the daytime scenes:

- A motivated 'cool' wash from stage right indicating daylight through the window for daytime scenes. This will provide our key light for these scenes.
- This wash might continue into the hall upstage of the door, which might indicate light through an open front door out of sight down that corridor.
- A 'fill' wash from stage left to complement this – colour will probably be strongly influenced by the set, since in a 'real' room this would be light that has bounced off the walls – however, we might want to signify other things than naturalism here.
- Functional washes to light actors when they are not directly lit with light from (or appearing to be from) the window. These probably need to come from the traditional three-quarter front-light positions.
- A wash that comes straight into the set from front of house, because our production of the melodrama (like many music-theatre productions) contains sections where actors directly address the audience – 'playing out' as it is sometimes called.
- Something to light the flats visible through the window (backing flats). I've indicated that LED batons from above and below might be useful – if they are available – since they will be able to provide a range of colours that will help us evoke different times of day.
- A three-quarter back-light from stage left – largely as a functional device to aid separation between performers and set. (From stage left rather than stage right because I see that working better with the 'cool' key light from the window.)
- Two 'specials' for the story-chair, one as a face-light and one as a back-light for additional separation/emphasis.
- A 'special' for someone lighting the fire.
- A 'special' for someone standing in front of the chest – which way they are facing and how much we want the audience to see of what they are doing will determine where this light comes from.
- An additional back-light for the second chair – perhaps influenced by something seen in rehearsals, perhaps because the director has asked for it.

In addition, for the evening scenes:

- A warm three-quarter back-light, enhancing the light from the practical floor lamp, and potentially providing a key of sorts for some cue-states.
- Something to provide a pool of light on the floor under the practical floor light. (This might be from the practical itself, or from a fixture in the rig.)
- A general back-light wash to help us indicate 'darkness' while still giving the audience enough light to see shapes and outlines. This will probably be in blue.
- A wash that goes with this, but which enables us to get some light on faces. This might be a

lower-intensity version of something we already have planned, or a new wash.

- Dusk-light through the window. Here, imitating nature does little to restrict our choice of colour since sunsets can produce many different colours.
- Fixtures to light the window backing flats – again the range of colours we might want to use, to imitate nature or for metaphorical or other reasons, might make a good argument for LED fixtures.
- A strong back-light to support the door entrance. It is a good idea to be able to support entrances with light, to help focus the attention of the audience and because directors frequently have actors make key speeches at or near an entrance. Here perhaps someone stands there and we want to see their shape before we see their face.
- Something from the fireplace to cast a large shadow of the storyteller somewhere prominent on the set. (In this case upstage of the window.) We will need to be careful with the intensity of the floor lamp practical if this is going to have a significant impact.
- A low 'special' onto the storyteller, perhaps to make their face look unnatural at times.
- A back-light special for someone standing at the chest of drawers – this time it appears that we don't want the audience to have a clear view of that person, just to be aware they are there. (Perhaps the actor removes a gun from one of the drawers, but we don't want the audience to be too sure which actor it is . . .)
- Something to cast 'ominous' shadows on the hall backing flats. (Perhaps the LD and director have talked about this as a good way of staging an entrance.)

These two lists form a starting point when it comes to designing the rig. They are by no means the complete description of what light, from which directions and of what quality and colour, will be used in the end design, but they do record some of the key ideas, and some of the choices still to be made.

A limitation of quick sketches on a rough plan view of the set is that this kind of sketch is a two-dimensional representation of a three-dimensional performance space. There's no obvious difference between arrows indicating light from high up and from below eye level. However, sketching on paper is a quick way to get ideas down in the rehearsal room or when you are reading the script, without getting too distracted by the process of recording those ideas. You might also try sketching onto rendered views of a digital model (such as those in Figure 3). The more finished look of the render can be distracting, but it can also serve to remind the LD what the set is to look like, particularly if the colours of walls, floor and other significant elements are accurately rendered (and printed).

With advances in digital modelling, you might try adding light directly into a digital model. I find this much can be helpful for experimenting away from the rehearsal room. However, in the rehearsal room I find that the level of engagement I need to make meaningful experiments with light in a digital model means I can't engage with what is going on in the room – which is usually more important for me.

Once you have a list of the basic requirements for the lighting design, the next step is to decide how each requirement will be achieved.

Designing washes, thinking in boxes

To make the right choices, about equipment and placement, an LD needs to be able to think in

three dimensions. This is especially true when it comes to choosing beam angle and hanging positions for units in a wash. Much of the time, we are lighting bodies in space and not the walls or floors around them. This is where we need to think about the usable box of light onstage produced by each unit and how we can seamlessly merge each one with its neighbours. The height of the box will depend to an extent on the height of the performers and whether they jump, but a safe general rule would be between 2 and 2.5m.

The whole of the box must be within the cone of the beam for it to be useful for lighting performers from head to toe (which we don't always want to or need to do). Outside the box to the right in the drawing (but with feet still in the beam onstage), the performer's head will be unlit. As the performer moves out of the box to the left in the drawing, we will lose first feet, then legs, torso and neck, until eventually their heads disappear.

To make this into a wash, we need to think of the stage being divided into similar adjacent boxes.

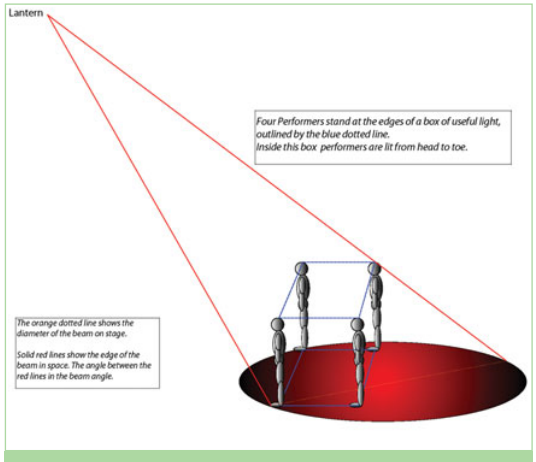

Lantern
Four Performers stand at the edges of a box of useful light, outlined by the blue dotted line.
Inside this box performers are lit from head to toe.
The orange dotted line shows the diameter of the beam on stage.
Solid red lines show the edge of the beam in space. The angle between the red lines in the beam angle.

Figure 5 Sketch of a conical beam and the useful box within it.

The size of the beam at the *top* surface of the box will give us a measurement of the diagonal across the top (and bottom) of the box. There is quite a tricky bit of geometry involved in working this out mathematically, but fortunately there is an easier way.

You will need a ruler and a protractor for measuring angles, a pencil and a scale rule, a lantern data book (or suitable trusted website) to find the beam angle of the lanterns you want to use, a good, fine-tipped permanent marker, a scale drawing of the ground plan and section of the performance space and some clear gel or acetate a little smaller in size than the section drawing. The section should be of the whole performance space, including all the places where you might want to rig Lanterns.

1. Look up the beam angle(s) of the lanterns you have available. If you are using zoom lanterns there will be two angles quoted. Use an angle halfway between the two. Let's assume you have ETC Source 4 profiles with 26-degree and 36-degree lens tubes.
2. Using the fine-tipped permanent marker, draw a line on the clear gel from the centre of one edge to an opposite corner. The start point in the centre of one side we will call the origin.
3. Working from the origin, carefully measure off the required angles from this line; for our Source 4s this will be 26 and 36 degrees.
4. Carefully draw lines from the origin at 26 and 36 degrees to the first line. You have now produced one of the most useful tools in lighting design!
5. On the *section* drawing, measure 2.5m (at scale) up from the performance level and draw a pencil line at this level and parallel to performance level. This line represents the *top* surface of our boxes.
6. Again with the section drawing, place the origin on a hanging position you know to exist

in the centre of the performance space with the first line touching the nearest edge of the area of stage you want to light.

7 Using the scale rule, at the point where the 2.5m pencil line crosses the lines on your new tool, measure the distance between the first drawn line and each of the other two lines. This is the diagonal of your 'box' for a 26-degree and a 36-degree lantern hanging at the chosen point of origin and focused into your area.

If you want to, you can mark up the ground plan with circles that will represent the size of the beams from that hanging position hitting that part of the stage. Halve the distance you measured in 7 above, and set a drawing compass to that radius, and carefully draw in the 'beam circles' on the ground plan. You will need to make sure you are drawing the right-sized circles by checking each 'throw' (i.e. each distance from hanging position to stage) on the section. Remember these circles represent the edge of the beam at 2.5m above stage height, so you will need to overlap them a bit.

In many performance spaces the section will not give an accurate measurement of the throw because the hanging position and the 'target' are

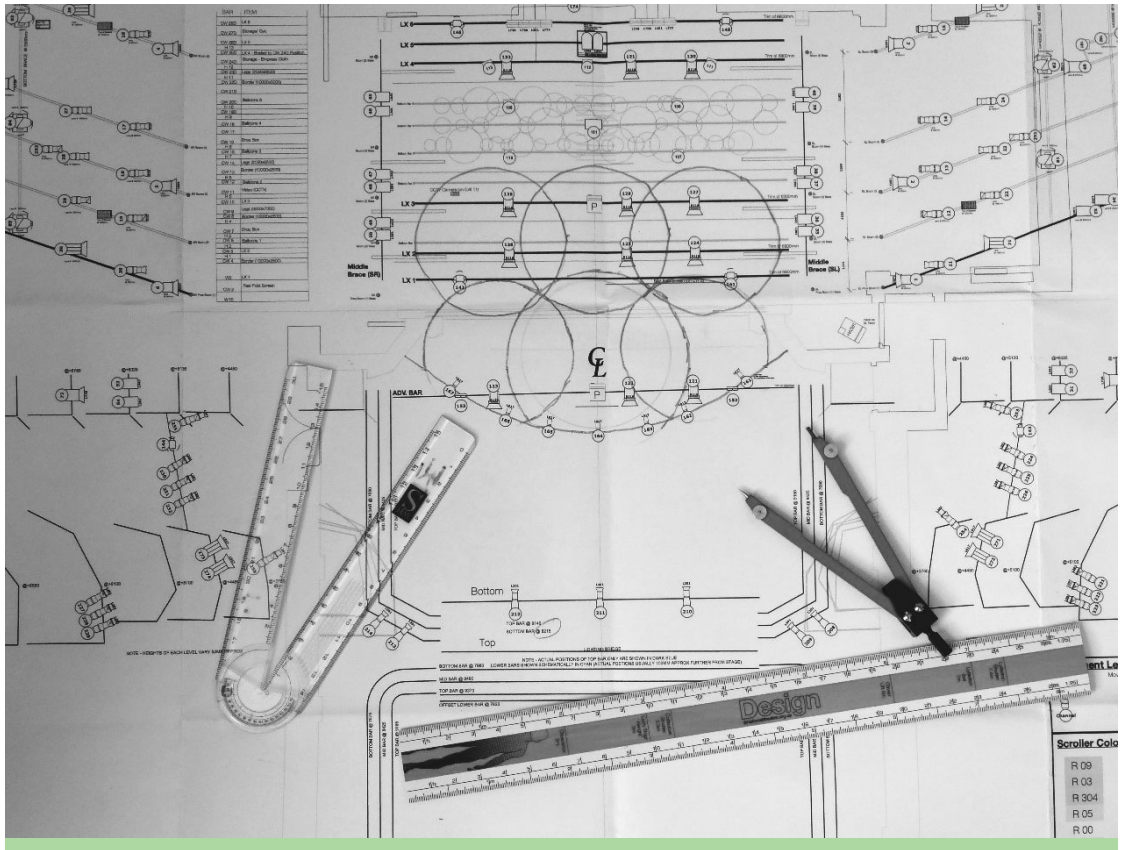


Figure 6 A lighting plan with circles sketched on to check the fixtures designed to cover the DS areas will work. (It's worth noting that the circle DSC is larger than the rest – to accommodate the curved edge of the stage. This means fixtures working DSC will perhaps need to be set wider than the rest – which could lead to other problems later.)

not in the same plane. If the hanging position is fixed to a side wall, for example, and you want a unit from that position to illuminate centre stage, the throw will not be the scale distance measured from the hanging position to centre stage on the section. To gain a reasonable idea of what size of beam you will have from this unit at centre stage we will have to do a bit more practical geometry.

1. Using the *section* and the correct scale ruler, measure the height of the hanging position above the stage. *Remember to subtract 2.5m* at scale because what we want to know is the diameter of the beam at the *top surface of the box*.
2. Cut a strip of stiff card to this length (the hanging position height minus 2.5m) in the scale of the ground plan.[5] It is a good idea if the card is thick enough to take a dressmaker's pin through the top edge.
3. Working with a scale ground plan of the whole performance space, draw a faint pencil line from the hanging position on the side wall to the approximate centre of the area you want fixtures from this hanging position to light.
4. Put the base of the strip on the ground plan at the point representing the hanging position.
5. Put the origin of your tool at the top of the strip. If you have a dressmaker's pin (or any other straight pin) handy, put this through the origin of the tool and use it to attach the origin to the top of the strip of card.
6. 'Point' the tool's beam at the area you want to light and you will get a good idea of what size the usable box of light will be.

You can repeat this process for each hanging position, producing a 'height' strip, and 'pointing' the beam where you want it to go. This approach can give you a reasonable idea of what to expect when you eventually get to the real performance space, and how many units of the available beam angle you will need to make up each wash. Referring back to the section can give you information about angle of incidence on the performer, and the amount of 'spill' you will get outside the usefully illuminated area. (Again, check back to Chapter 3 for more on what these terms mean to your design.)

When using this method, you will need to remember: Look out for obstructions!

It can be very easy to think you have found the ideal position for a unit only to discover that in the real space there is something in the way and the light will not get to where you want it to go. The obstruction may be part of the set, or the structure of the performance space, or speakers, or even other lighting units. In traditional theatres, the proscenium arch gets in the way of lots of things! It's a good idea to ink over any lines on the ground plan that represent structures that might get in the way, so you don't forget about them.

There are a few apps out there that will give you a good idea of what size beam you will get from a specific throw with a certain beam angle.[6] Remember once again that you are usually not aiming for an even cover at floor level but at head height – say around 2m to be on the safe side.

Most of the CAD packages for performance lighting will give a reasonable approximation of

[5] Usually the ground plan and section are drawn at the same scale, so you could measure the distance and the length of the strip of card with a standard ruler. Just occasionally though, for all kinds of reasons, the section and plan are drawn at different scales! You should always check both the scale of whatever drawing you are working with and the ruler you are using.

[6] At the time of writing, I often use the app LD Tools.

Figure 7 If you have a good model box available you can use a small torch to check what shots are and are not available from each hanging position. This can be especially useful when you are deciding where to place any moving fixtures in your rig.

what the beam of a chosen instrument will look like onstage. To do this involves creating the performance area in 3D virtual space, which, depending on how much detail you need, can be a long process. However, if you have the computer model of your performance space, this is undoubtedly a good way to try ideas out. Putting a model performer into your digital space can also let you see where the shadows are likely to fall – if the software is able to model light in the virtual space.

Whichever method you use can also help you to see what moving lights hung in each hanging position will and will not do. Most moving lights have a zoom function, so using an angle somewhere in the middle of the range quoted by the supplier or manufacturer is often a good idea. That way, you are much less likely to be caught out if the fixture does not do quite what the data sheet says.

Do working LDs do this for every lantern on every rig? No of course not. It is possible to train yourself to be good at guessing how many 26-degree lanterns will be needed to do a particular job. But almost every LD I have talked to does some checking of beam angles and throws in the process of designing their lighting rig. Most mistakes arise from failing to do this.

Planning washes

The size of each area in a wash will usually be slightly larger than the space occupied by a performer with outstretched arms, say between 2.5 and 3m wide. Any smaller and the areas become harder to blend into a unified wash. Much larger and we lose too much control over the differences in the light at different places on the stage. On a larger stage you might go for much bigger areas and use specials when you need selectivity.

Usually odd numbers work better in dividing up the stage if for no other reason that they give us centre-stage areas. Performers and directors very often like to do important stuff centre stage.[7] In many situations, an LD needs to be able to bring up the intensity of centre stage relative to the rest of the stage. If we have an even number of equally sized areas across a roughly symmetrical stage, there will be no single area in the centre, and consequently the lighting design will not be as able to use a wash based on these boxes to concentrate audience attention centre stage.

Other factors can override these considerations at times; for example, you may be limited by the number of lanterns or dimmers available, or the number of suitable hanging positions – or by the amount of time you have to focus the rig. (The more lanterns you have the longer the focus takes and the less time is left for creating cues and evolving the performance.)

Say our active playing area is around 8m wide (just over 26 feet) and about the same deep. We can think of it as a 3 × 3 grid of cubes, each just over 2.5m wide (8 feet), deep and high. We can name these nine areas using the conventions of British and North American stage practice (see Figure 8).

Upstage Right (USR)	Upstage Centre (USC)	Upstage Left (USL)
Mid-stage Right (MSR)	Mid-stage Centre (MSC)	Mid-stage Left (MSL)
Downstage Right (DSR)	Downstage Centre (DSC)	Downstage Left (DSL)

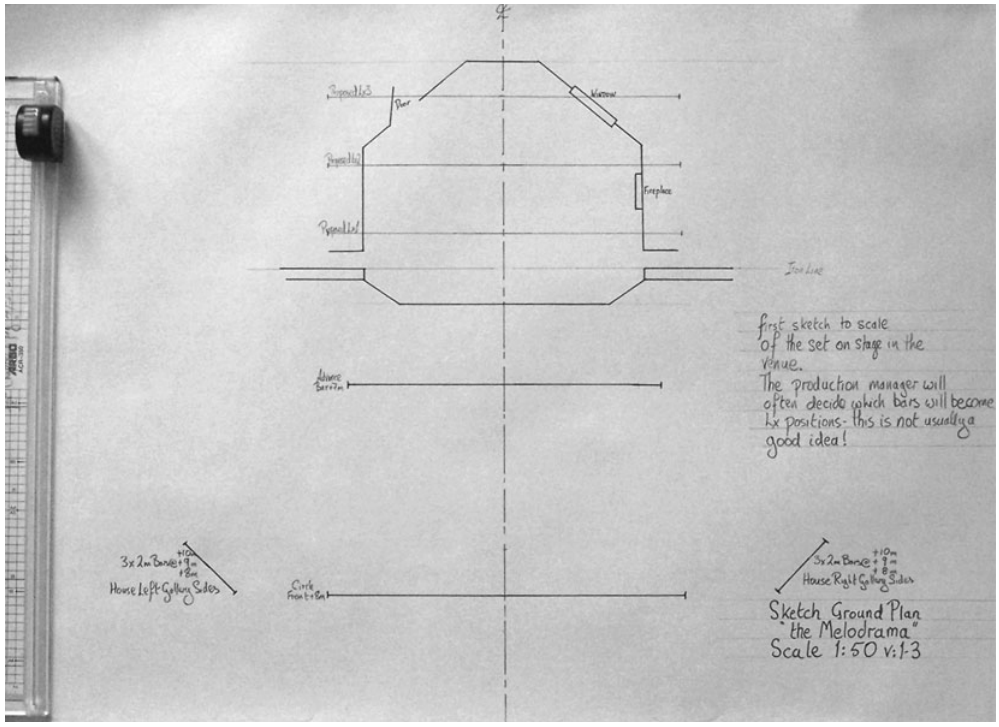
AUDIENCE

Figure 8 Dividing the stage into nine boxes.

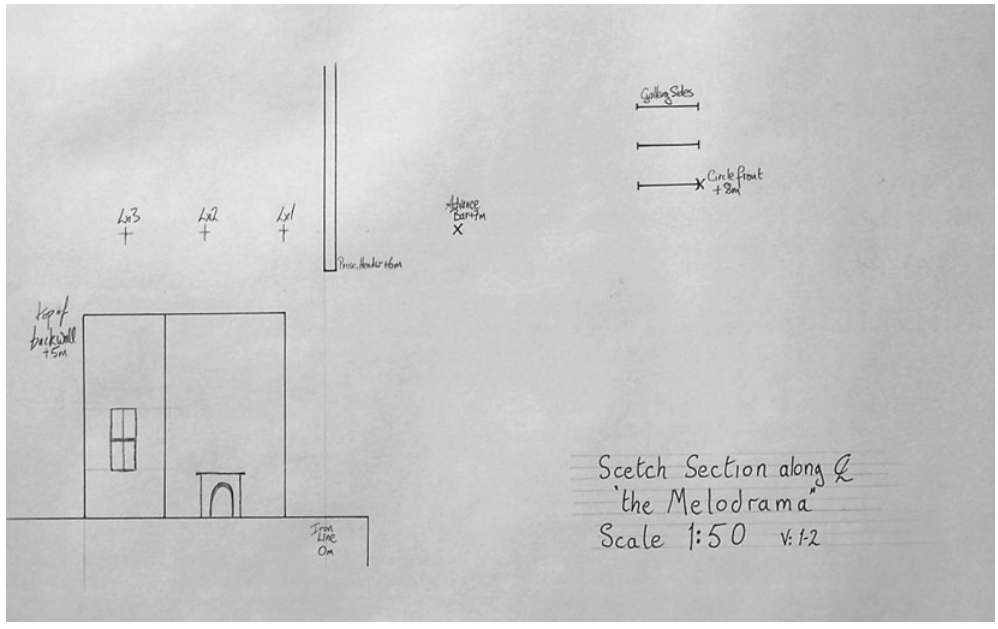
Let's imagine a traditional proscenium theatre, such as that in the sketch plan and section in Figures 9a and 9b.

Let's start by placing three profiles on a convenient 'straight-in' position front of house for the beginnings of the first wash. In this imagined theatre this position is called upper-circle front. I can use the plan and section with an appropriate scale rule to determine that this hanging position is about 8m from the front edge of the stage and 8m higher than the stage. Using a simple section drawing and a scale rule, I can find out what the throw will be to the centre of the downstage three 'boxes' (~10m) and from that the required beam angle (about 15 degrees for a 2.5 to 3m wide beam at about 2m above stage). Placing three 19 degree Source Four lanterns on the upper-circle front, evenly spaced, should fill the most downstage three areas with front-light. The angle of incidence is a little shallower than I would like, meaning (among other things) that the 'spill' outside the useful area will be larger, extending well into the three mid-stage areas. I may need to

[7] The point about centre stage is that it is very often the natural 'focus point' of the performance space, the area from which the performer can most easily become the centre of audience attention. This is especially true for stages in conventional proscenium theatres. For all configurations of performance space, one of the major factors influencing the decisions of designers and director will be the position of the natural focus of audience attention on the stage. For now we will assume that this is 'centre stage'.



(a)



(b)

Figures 9a and 9b Sketch ground plan and section of the stage and auditorium of an imagined proscenium theatre, with the set for the melodrama. Very often the plans you receive for a production will be of the stage only, and you will have to draw your own version to get the auditorium in.

have an alternative if I need really tight definition of one or more of these downstage areas. However, the slightly shallower angle will help get light under heavy brows and into the eyes of the performers.

I want some modelling light from front of house too, and I will need something to facilitate both 'warm' and 'cool' looks across the whole acting area. The traditional 45-degree positions will do this well – on the ground plan for this theatre (Figure 9b) they are called 'gallery sides'. We can use the same techniques applied above to determine the required beam angles for lanterns from these positions focused to our downstage areas, DSL, DSC and DSR. Depending on your assessment of the needs of the production, we might place a single set of three lanterns each side, and plan to colour one side 'cool' and the other 'warm'. Alternatively, to provide greater flexibility for the lighting design we might want a 'warm' and a 'cool' set of lanterns at each side, and perhaps a 'neutral' set too, or provide colour changers for each unit. (Of course this assumes we have the budget/dimmer circuits/space at the hanging position for the additional lanterns, or budget and suitable control for colour changers.)

In many theatres in the UK and elsewhere, it is likely that the venue supply zoom profile lanterns specifically for these positions. The advantage of zoom lanterns is that the beam angle can be adjusted to suit the role required of the lantern. In this case, the throw for a lantern focused from the 'gallery side house right' position to DSL will be shorter than that for a lantern focused to DSR from the same position. Consequently, the beam angle required for the first lantern will be larger than that required for the second. Zooming a profile lantern is not the same as reducing the beam size with an iris – as you zoom the beam down (making it smaller) the beam gets brighter – roughly the amount of light is getting more concentrated into a smaller beam. We also know that as we move away from any light source the intensity reduces following the inverse square law – move twice as far away and the intensity reduces by a quarter. With luck, the reduction in intensity due to the extra throw will be compensated for the increase intensity due to the zoomed down beam angle. This appears to work out most of the time – which is great. If the design has to incorporate fixed beam lanterns from these positions, it will often be necessary to proportionally reduce the intensity of the lanterns with the shorter throws in order to achieve an even intensity from that angle across the whole stage. However, since incandescent lanterns at different intensities produce light of different colours (due to the difference in colour temperature of the filament at different intensities – see Chapter 2) this is not always an acceptable solution.[8]

Having addressed the most downstage areas, I now need to consider the rest of the stage. The whole idea behind creating an even wash of light is usually to give the audience the impression that the area is a single unified space – that performers moving through the lit space are all in the same 'world' – same time, same location, same feel. To do this the audience should not be aware that, as performers move through the space, they are lit by different units. We know already that light from different angles of incidence lights the body differently – indeed we can use this as a signifier in a design. With this in mind, we need to try and

[8] This problem can be addressed by using neutral density filters on the lanterns with shorter throws. These filters – more often used when lighting for camera than for the eye – are designed to reduce the intensity without altering the colour temperature. This can be very useful if you have to use the same dimmer for two lanterns, one of which has a much shorter throw to the target than the other.

match reasonably closely the angle of incidence of each unit within our wash group.

You may have realized that we have already failed to do this with the 45-degree wash from the gallery sides. The angle of incidence from these positions will be greater for the units focused to their own sides (the ones with the shortest throws) than for the units focused to the far side. This gradual change in angle across stage is not usually significant enough to cause problems.[9] What will create noticeable changes in 'feel', however, are sharp and significant differences in angle of incidence on the performers as they move between lighting areas. I need to ensure that the next sets of lanterns placed on the plan to light the mid-stage and upstage areas will blend in with those already in place to light the downstage areas.

The 'straight-in' system that began from the upper-circle front could be continued from the advance bar. The angle of incidence to the centre of the mid-stage areas from this position is about 40 degrees – slightly steeper than the 35-degree angle we have from the upper-circle front to the centre of the downstage areas. These angles of incidence are probably sufficiently close to work for the design and blend into a single wash. The slightly increasing angle will help us in that it will decrease the spill area upstage and give better control of these mid-stage areas. However, this same increased angle of incidence will also tend to create shadows over the eyes of some performers. Helping out here, though, is bounce light. The amount of bounce light around will depend on a number of factors, including the colour and texture of the walls and floor of the set. What will almost always be true, however, is that there will be more bounce from front-lights the further up-stage you go – simply because as performers move further upstage there are more lit surfaces downstage of them for light be reflected off. Generally speaking, then, we can use steeper angles the further upstage we go. In my rough sketch you can see that by the time we get to lighting the upstage areas from LX1 the angle of incidence is about 50 degrees. This increasing angle also helps to reduce the length of potentially distracting shadows on the back wall.

Again using a suitable section and a scale rule, I can determine that the throw from the advance bar to mid-stage is about 7.5m and the beam angle required to produce a beam 3m wide from that distance is just over 18 degrees. This presents me with a tricky problem. Many ranges of fixed-beam angle lanterns come in 19 degrees, 26 degrees and 36 degrees, including the popular ETC Source Four range. Do I choose a 19 and hope our calculations are correct, or play safe and go for a 26, but live with less light onstage (the 26-degree lantern will be less bright because the same amount of light is spread over a larger area)? The decision depends on several factors, including the amount of confidence you have in the measurements provided to you, the time available to rectify any mistakes, availability of equipment and how much you intend to shape the beams using shutters. All other things being equal, this last is often the key one for me. In order to be able to utilize the shutters of a profile lantern, there has to be a 'spare' beam to 'get rid of'. In most situations, I would play safe and go for the 26-degree lantern in order to be sure I had enough 'spare beam' to shape.

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[9] Having said that, many contemporary LDs working in Europe make much less use of these positions than did the previous generation of practitioners. Working in a style with fewer sources does tend to show the weakness of some traditional techniques, including extensive use of 45-degree front-light systems. If you are attentive to the work of contemporary LDs, you will see many alternative solutions to the problem of providing illumination for faces.

Using the same techniques as before we can establish that to continue the 'straight-in' wash into the upstage areas from LX1, the throw will be about 6.5m and the required angle will be 21 degrees. The set gets narrower upstage so we will have no problem choosing 26-degree units to complete this 'straight-in' wash or 'system'.

Completing the 45-degree front-light wash raises more questions. I could attempt to cover the whole stage from the gallery sides. Yes the angle of incidence will change as the performers move onstage, but because all the light really does come from more or less the same place, blending the discrete sources into each other is much less of a problem. If these units are to be used primarily to fill shadow and aid depth perception then the differences in angle of incidence will probably not be registered. If, however, they are to provide the apparent source of illumination, it could be difficult to maintain the similarity of feel across the whole stage.

There are several other problems to be addressed if we are going to try and use a position like this to site a full stage wash. First we may not be able to see the whole stage from this position – especially in a proscenium theatre. If the set has walls, as ours does, this might not be too much of a problem as bounce light may well help out in the hard to reach upstage corners on the near sides.[10]

Sketching a ground plan to scale can be a good place to try out ideas. Supposing we decide to light as much of the stage as possible from the gallery sides; using the sketch section and ground plan we can estimate how much the angle of incidence changes across our set. I have measured the horizontal distance on the sketch ground plan and we know from the theatre's information pack or from our own measurements that there are bars at 8m, 9m and 10m above stage level at both the gallery-side positions. From sketching on the ground plan I can see that I only usefully focus on six of the nine areas from each of these positions. From house left these will be: DSL, DSC, DSR, MSL, MSC and possibly USL. From house right the six are: DSL, DSC, DSR, MSC, MSR and possibly USR. The upstage areas are probably the ones least usefully lit from these positions – they have the lowest angle of incidence and therefore create the longest shadows and the largest spill area (and that spill will create potentially distracting shadows all over the corners of the set – something we are unlikely to want). We will leave placing these units for now.

The beam size here will be the distance across the diagonal of each area since the light is striking the area from the diagonal rather than from straight on as in the first examples. This means the beam size needs to be about 3.25m rather than the 2.5 to 3m used previously. Some quick calculation using the data sheets or an online beam calculator gives us a range of required beam angles between 10 and 15 degrees, well within the working range of most long-throw zoom profile lanterns.

If we have nine available hanging positions on each side (three at each height), we need to decide where to place the units that will light each of the six areas. To achieve our aim of a smooth even wash, we need to minimize the change in angle of incidence between any two adjacent areas. In practice this means 'don't cross the beams'.

Specials

Let's take this opportunity to place our first specials. We know from reading the play and

[10] These corners are in any case unlikely to be important areas of the performance space, especially if some sections of the audience don't have a perfect view of them.

talking to the director that we need to be able to isolate the chair and there will be a dramatic moment when a character comes in through the door and stands there. We already have a plan to light the chair from a small unit on the front of stage,[11] and the entrance special is probably going to work better from a steeper angle.

Provided you have the budget and the dimmers, it is often best to hang and focus 'extras' as a back-up. Thinking about the upper-circle front and gallery-side positions, you can be more or less sure that units from these positions will light performers' faces – it may help out key cue states to have just a touch from front of house to add a sparkle to the performer's eyes, for example. Also, units in these positions can usually be re-focused quite quickly, or at least without having to get access equipment onto the stage – so if the position of the chair changes I can get the fixture refocused without having to clear the stage and access the overhead lanterns.[12]

Before we leave the gallery-side positions, we have space to hang another few units. How about some colour fill from here? We can work out that a 25-degree beam angle would create a wash from a single lantern that would fill the whole of the stage that is visible from the gallery side – taking some account of shuttering. It could be really useful to have (say) a deep-blue wash to fill the shadows at certain moments, or perhaps to 'fake' darkness.

An alternative to continuing the 45-degree wash from front of house is to use lanterns from the overhead rig on the advance bar and on stage. Again using a sketch ground plan and an app such as LD Calc, we can determine that the throw to mid-stage from the advance bar for this system would be about 8.5m requiring a unit with a beam angle of around 16 degrees – but that we will probably only be able to see two of the three mid-stage areas from each side. The angle of incidence from the horizontal will be about 40 degrees, which should be close enough to the angle of incidence from front of house to allow smooth blending between these areas. From LX1 the angle to the upstage areas will be steeper – around 55 degrees – and the required beam angle will be about 22 degrees, indicating Source Four 26-degree units. Once more the stage-left area will only be lit from stage right and the stage-right area only from stage left.

Pipe-ends

Because of the set walls, the only light from the sides we can get into the mid-stage and upstage areas will be from the overhead rig (rather than from booms, say). As we have said already, whenever the actors are facing each other across the set, light from the side is likely to be of more use for faces than light from the front. One very useful way to do side-light from overhead is referred to as pipe-end lighting.[13] Two (or more) units from near the end of the overhead lighting bar are focused across stage. These units can also be used to provide modelling and colour. The usual way to focus them is for one unit to cover the far side of the stage and the second to continue that, at least to the centre line. This determines the required beam angle. On more

[11] Look back at the cue synopsis towards the end of Chapter 5.
[12] If I still want to use lanterns from the overhead rig I can re-focus them at the next suitable break and then re-plot the cue. In the meantime the rehearsal can continue – there is still a special on the chair, there is still a meaningful cue to time, place and respond to, and the piece can continue to develop.
[13] This name comes from the North American practice of calling lighting bars 'pipes'.

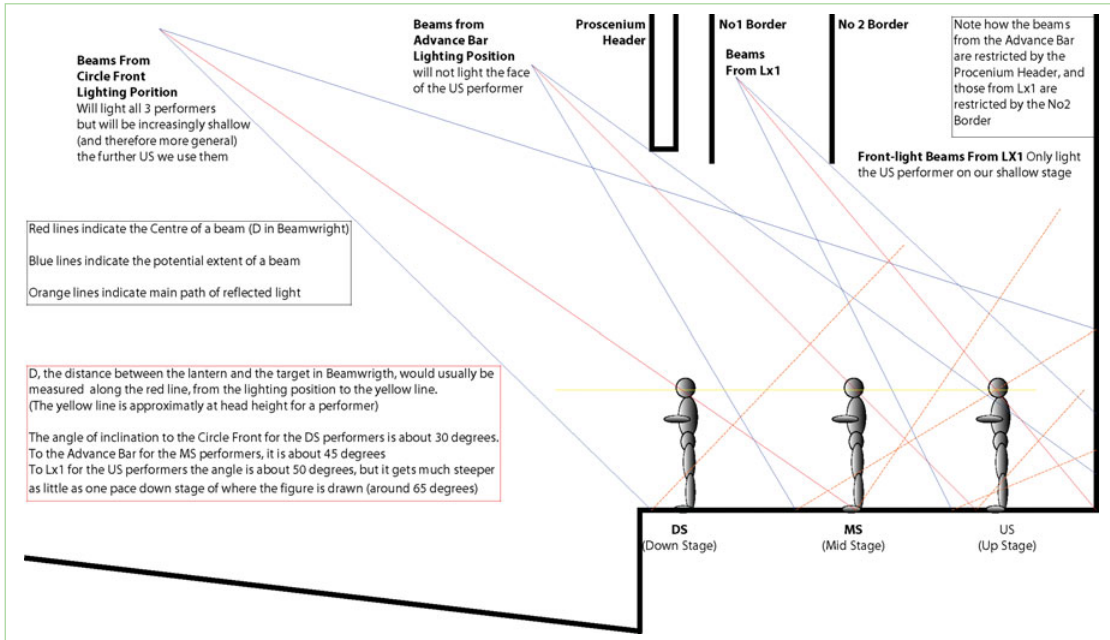
Beams From
Circle Front
Lighting Porition
Will light all 3 performers
but will be increasingly shallow
(and therefore more general)
the further US we use them
Beams from
Advance Bar
Lighting Position
will not light the face
of the US performer
Proscenium
Header
No1 Border
Beams
From Lx1
No 2 Border
Note how the beams
from the Advance Bar
are restricted by the
Procenium Header, and
those from Lx1 are
restricted by the No2
Border
Front-light Beams From LX1 Only light
the US performer on our shallow stage
Red lines indicate the Centre of a beam (D in Beamwright)
Blue lines indicate the potential extent of a beam
Orange lines indicate main path of reflected light
D, the distance between the lantern and the target in Beamwrigth, would usually be
measured along the red line, from the lighting position to the yellow line.
(The yellow line is approximatly at head height for a performer)
The angle of inclination to the Circle Front for the DS performers is about 30 degrees.
To the Advance Bar for the MS performers, it is about 45 degrees
To Lx1 for the US performers the angle is about 50 degrees, but it gets much steeper
as little as one pace down stage of where the figure is drawn (around 65 degrees)
DS
(Down Stage)
MS
(Mid Stage)
US
(Up Stage)

Figure 10 Centre-line section – used here for calculating required beam angles and to assess the amount of bounce light from the floor that might be available.

open stages PAR 64s are often used, though here we might want a bit more control in order to be able to light the set sensitively. If we want to keep this (potentially) coloured light off some of the set we will need barn doors and the flexible beam angle offered by Fresnel lanterns. We shall need to sketch another section to work out beam angles and positions – this time across stage. The same drawing will serve for placing lanterns on LX1 and LX2.

From the sketch we can see that we will need units with a beam angle of between 25 and 40 degrees – almost any Fresnel unit will do this, so the choice is wide. For extra control we could use profiles. This second sketch shows us that light from these units can have a small front-light component for the mid-stage and upstage areas. It will probably be useful to continue this 'high side-light' into the downstage areas by placing a pair of fixtures at each end of the advance bar. This would usually restrict the choice of unit to profiles, because any other kind of unit would produce too much distracting stray light on the proscenium.

There will be a large difference between the angle of incidence on, for example, two performers both lit from stage left, one onstage left and one onstage right. However, the change is gradual across the stage, and it is unlikely that pipe-end systems will be used as the key light for the whole stage.

This position is frequently used to add texture to the lighting design in the form of a gobo wash. If this is the intention we would normally base all the calculations on the size of the beam at stage level, not at performer-head level.

Getting more specific

Having established what units from where will be used to create the main washes for the piece, the

next step might be to look at how we can deliver some of the specific qualities of light into the set that came out of earlier text analysis, the set design and from watching rehearsals.

Direct sunlight or moonlight through a window will usually be even in intensity across the beam, which will have a well-defined edge[14] – a bright sharp-edged image of the window somewhere in the room. The relative location of this image and the window will – consciously or subconsciously – tell the audience where the light source is.[15] Along with direct sunlight, there is also more diffuse light reflected from the sky and nearby structures, and light diffused by cloud, mist or fog. This more diffused light has a much softer quality, gently falling off in intensity towards a loosely defined edge. It can be an important dramaturgical point to decide if and when the sun or moon will shine directly through the window and into the room, and what it will shine onto. What will the direct sunlight (or moonlight) illuminate? Maybe direct moonlight catches the storyteller at a key moment, or sunlight reveals the identity of a character who had previously been half-hidden in shadow.

It is highly likely that we will want light to come through the window, if only to aid the realism of the set. (This is the main reason that we don't want glass, plastic or even fine netting in the window panes. Glass or clear plastic causes unwanted reflections, and any marks or dirt show up in bright light and can cause distractions.) If the right hanging position exists (or can be made), we can choose to shine light through the window with an appropriate throw and angle of incidence to put the image of the window in the right place onstage. This will create a bright image of the window aperture onstage. However, we can't light the whole set from this window, so whether we are imitating direct light or only the diffused light, whatever comes through the window will need the support of the window-light key-wash.

If that's not possible, however, we might choose to use a gobo in a profile fixture, from near the stage-right end of LX2, to imitate the effect of direct sunlight through the window. How this imitation will work will depend on several things, including whether the gobo pattern matches the window in the set and where on stage you choose to place the image (maybe you use a moving light that very slowly pans across the stage to imitate the passage of the sun across the sky). We would also need to think about what happens to the gobo/image when someone is close to the window. Will the audience notice this person does not cast a natural shadow?

But how closely do we want to 'imitate' reality? On stage, if we used a profile fixture to imitate direct sunlight (or moonlight) with or without a gobo, the sharply defined edge to the beam may well become distracting as performers move in and out of it.[16] A Fresnel fixture may create an effect less like direct sunlight in a 'real' room, but it may be more appropriate onstage than the more technically accurate profile beam with its well-defined edge. The diffused light through the window would, if it were real sunlight outside the window of a real cottage, directly light only that part of the room directly in line with the window,

[14] Next time you see direct sunlight coming into a room through a window check this out.
[15] In the language of semiotics, this might be thought of as an *indexical sign*, pointing to the thing it is signifying.
[16] Remember the attention of the human eye is drawn to the sharp edge of a beam – the rapid change in intensity – much more than soft edges. A performer moving through the sharp edges of beams of light attracts audience attention, and this can easily be distracting.

leaving much of the rest of the room lit only by the diffuse scattered light of reflections from the floor, walls and ceiling. (Of course in most situations on stage we don't have all of these available as reflective surfaces.)

It may be useful to have so much of the stage effectively unlit. Even if we (director, designers, performers) have all agreed in the rehearsal room that this is what the play needs, it is a good idea to be able to extend the wash to as much of the stage as it is practical, in case we all change our minds once we are in the theatre. In this case, I would want to be able to begin the window-light key-wash much nearer to the door upstage centre, to cover performer entrances, and to be able to choose to extend it a little more into the corners of the room. Just how selective we want to be usually determines the size of each box of light and consequently the number of units we use in the wash. Basically, more units = more selectivity (but also potentially, more time to focus, more units to hire, more dimmers to find – all of which adds up to more cost).

Balancing the wash that supports the window key light is a fill-light wash. The aim of this wash is to fill enough of the shadow created by the window-light to aid visibility, without undermining that key light. For example, it will need to light actors' faces when they have their backs to the window without spoiling the appearance that light is coming from the window. In nature, this light would be reflected from walls, ceiling and other surfaces – highly diffused and perhaps coloured by the things it has bounced off. It would not create much if any shadow. On a more open stage, we might use fixtures mounted on booms at the side of stage, say between about 2m and 4m high, pushing low-intensity diffused light with a shallow angle of incidence into the space. Here (as so often in drama) the walls get in the way. We have several options, including pipe-ends from stage-left, a boom in the gap between the set and the proscenium arch (pros-boom) and positions front of house.

This wash is largely there to solve a practical problem, making actors and objects visible without creating distracting shadows or undermining the key light. We should also consider what dramaturgical functions this wash might serve: could its colour have metaphorical or emotional significance? When used at higher intensity, could the change in key light direction signify something? There will be some light from the fire, particularly in the evening scenes. This wash is potentially able to support a single key light from the fireplace, if it is coloured appropriately. Elements of this wash might also be useful in supporting whatever we use to create the impression that light is coming from the floor lamp, again with an appropriate colour. It is worth considering how elements of the wash might also be used as specials too, for example onto an actor in each of the chairs.

Choosing colour

Part of being a designer, any kind of designer or artist, is noticing the world around you. For a lighting designer it is important to notice how the quality of light varies and how this affects our perceptions of the atmosphere in a space. One of the biggest variables in the quality of light is colour. A good LD notices the colours of light in nature and elsewhere. The dominant light sources we are aiming to represent or evoke here are sunlight and moonlight through the window, firelight from the fireplace, and domestic lamplight from the floor lamp. Sunlight varies in colour – depending on place, time and season. Moonlight too comes in a range of colours – not all of which are blue. Firelight and domestic

electric light are quite well defined in colour and colour temperature, as we saw in Chapter 2. If the floor lamp is meant to be an oil lamp or a candelabra the colour temperature will just be lower. So too as the fire dies down the light from it reduces in intensity and gets redder.

We can choose to follow nature, attempting as far as possible to use light that is the correct colour temperature and composition for each of our key-light sources. While this is often a good starting point, it is important to remember just how subjective human perception of colour is. The way in which we perceive colour is hugely dependent on both what colours dominate the visual field at that moment and on what colours dominated in the immediate past. There will be sets in which what should be the technically correct colour or colour temperature light just does not look right. This can remind us that the show is not just about lighting, and the success of the overall design depends on set and costume looking *right* in the light you design. Whenever you can, try out your lighting colour ideas with the set and the costume designers, and with samples of the paints and materials they are using. This does not need to be a process where only the colour of the light is debated – you could all decide that for a particular lighting effect to have maximum impact the colour of a wall, the floor or a costume should change. This can usually only happen at an early stage in the process, before the walls have been painted, the floor covering ordered or the costume made. Starting your collaboration early can give you much more opportunity to be creative.

Colour changers

If you want to use light of more than one colour from a hanging position, you have two choices. Either rig another fixture with a different coloured gel alongside the first, or use some way of changing the colour of light from the first fixture. I mentioned scrollers earlier, but these are increasingly being replaced by fixtures with colour changing built-in.[17] These include moving lights and static LED fixtures, as discussed in Chapter 2. When you change the colour of a key light by fading out one unit and fading in another, there can be two shadows during the transition and this can be distracting. One big advantage of using units that seamlessly change colour in a programmable way is that there is only one beam and one shadow.

Having said all this, one potential pitfall of using fixtures with an almost infinite colour range is that it encourages the LD to put off making choices about which colour to use when. This can lead to time lost during the tech while you all decide which colour works best – and the LD losing control of the colour palette of the show as the director asks to see it 'all in something pinker'!

The colour palette of a production is a major component of the scenography. It has the power to fundamentally affect the audience and their perception/reception of the piece. Go back to look again at some of your favourite films and notice how many of them use tight control of the colour palette to aid atmosphere and help tell the story. Colour will play a major role in your lighting design. Don't leave decisions regarding your

[17] Since their introduction in the early 1980s, scrollers have served us well. However, they do have disadvantages including noise from fans and when they change colour, which can lead to issues when it comes to programming them. When using scrollers you have only the colours in that string available, and they are in a specific order – in other words if you want to change colour from pink to amber you may have to go through several other colours to get there. It is likely that scrollers will largely disappear from most lighting rigs before too much longer.

colour palette till you get into the performance space – even if you have got the latest LED fixtures with a million colours.

Other apparent sources of light

In the first sketches we identified several other sources of light.

First, let's look at the low source from downstage that will cast a shadow of the Father in the chair. The original sketch had a position on the downstage edge for a birdie. The line passing through the centre of the birdie and the chair gives us an approximate position for the unit – however, experience tells us that this is probably something that will need to be worked out on the performance stage in order to make sure we get the best possible result. A note on the plan is usually enough to indicate that this unit has yet to have a defined final position.

The fire will need to glow – and that might come from a source built into the set, but we might be able to add extra 'glow' from the rig – shining a narrow beam of suitably coloured light from (say) LX2 to mimic the light from a fire. There are various effects that could be used with the lantern providing this light, including a static gobo, a slowly rotating gobo, or a gobo and an effects wheel in front of the unit. Either of these latter two could provide some subtle movement within the beam, again imitating light from a fire. However, since we are projecting this light onto the fire rather than making it actually come from the fire, we will have to be extra careful, first to make sure the effect we create really does look to be coming from the fireplace, and second to make sure it will not hit any of the performers and give away its true source.

The sky outside the window will need to show (at different times) late afternoon, sunset and evening. This will need the appearance of light from above the horizon, a 'warm' glow on the horizon and perhaps even stars for evening. The sky is visible behind the stage action for almost all the audience, and will be our best way of indicating time of day through the play. Clearly the lighting on it will have an important dramaturgical impact on the piece. We will need to talk to the set designer and others to make sure the material used for the 'sky cloth' will be suitable for taking light, and that there will be enough room to place our lanterns, top and bottom.

One important consideration is will we be able to light the 'sky' from behind. Some materials can usefully spread out light for us when lit from behind, turning the light from several individual floods into a smooth even wash. However, if there are structural elements of the frame that supports the 'sky' across the back of it, these will create ugly shadows. Squeezing in sufficient equipment to provide the number of different looks required by the script can be tough, especially if we are restricted to lighting the 'sky' from the small area between the back of the window flat and the 'sky' frame. Two or three colours of flood light from above and below would be nice – a sky blue for daytime, some warm sunset colour and perhaps a 'night-time' blue for evening (since this is likely to look better than leaving the 'sky' unlit in the evening scenes – unlit often looks 'dead' onstage).

If LED equipment is available, perhaps this would be an ideal place for it. LED strip lights generally have clusters of three or four different coloured LEDs and offer control of colour and overall intensity by mixing the light from each colour. They don't need dimmer channels, just a few DMX control channels. LED batons are relatively compact, can be used very close to scenery, since they don't get as hot as conventional units, and generally come with a range of diffusers to spread their light as required. Some units are

available with a suitable range of colours and smoothness of dimming – but it would be wise to try out whatever you are offered before committing a substantial proportion of budget to this solution.

Lighting 'sky cloths' and 'cycs' can be enormously rewarding. When it is done well, a simple piece of cloth turns into the infinite and variable heavens, able to signify not just time and place, but whatever dramaturgical qualities are called for by the production. When it is done poorly, the simple piece of cloth remains a piece of cloth, with no potential other than to disappoint.

Apart from the sky, we want moonlight through the window. If there is enough space, this might just be possible to achieve by placing a lantern so that its beam shines through the window and casts a beam framed by the shadow of the window frame, just where we want it. This will often be the ideal solution, a large Fresnel – perhaps even a discharge source such as an HMI – rigged so no audience member can see it, and in such a way as to create the shadow of the window frame where its dramatic significance can be most clearly read by the audience. It's not going to happen here though, because the back wall of our little theatre gets in the way. What can be done, however, is to use a suitable gobo in a profile lantern on LX3 to 'fake' the moonlight shadow where we need it. This will need to be supported by suitable lighting of the window frame to simulate light coming through it (perhaps by 'birdies' just out of sight of the audience, attached to the back of the set). Just as with the faking of firelight, however, we will need to be sure that no performer is going to disrupt the 'trick' by, for example, standing at the window and *not* being in the shadow cast onstage! Ensuring this trick works for the play could involve a series of conversations with the director and set designer where the LD has to speak both for what is dramaturgically desirable and what is practically achievable. In these situations it is often useful to remember that a well-presented illusion can be stronger than a poorly supported simulation of reality.

On the opposite side of the set is the doorway. The direction the door opens has been chosen to allow a performer to enter, opening the door and standing framed in the doorway, without the door blocking sight of her for any of the audience, and without having to stand back as she would if the door opened towards her. This allows us to place a suitable lantern offstage and above head height, back-lighting this position and making it stronger still. This lantern will create a beam that casts a shadow of the opening door in the doorway. Working with a suitable section, we can make a reasonable estimate of where the shadow will fall for different achievable hanging positions. From a height of around 3m – say on a lighting stand at the offstage end of the backing flats – the beam could fall across the chair! If the lantern hangs higher, the beam will not spread so far across stage, and the shadow cast by anyone standing in the doorway will be smaller.

We put in a front-light special for the doorway from the gallery-side house right. I would want to add a steeper (and therefore more selective) light – say from the far end of LX1, in the same cool colour as the three-quarter wash from stage left. This gives us alternatives for the entrance.

We will also need to light the backing flats themselves. If they represent another room, light in that room will at sometimes be daylight and at other times lamplight, so we will need different sources to show this. We will also need to think about the shadows cast on the flats by performers entering or exiting. If we cast long shadows here, it will extend in time entrances or exits. The audience will see the shadow before the performer for an entrance, and for an exit continue to see the shadow of a performer for a little while after that performer has left the room. The impact and

desirability of this will need to be discussed by the artistic team.

Practical units onstage[18]

Finally, we have a standard lamp onstage. For the evening scenes this will be the apparent source of light (along with the fire). As well as the key-light wash the colour of a domestic tungsten lamp from upstage left (the PC on LX3 we have already mentioned) we will need something to enhance the effect of the practical fixture on the walls and floor.

If the performance space is small, and the show lighting is not too bright, the unmodified practical itself may create a suitable effect on walls and floor. In larger venues the amount of light required onstage increases – just to provide enough visual acuity for more distant spectators. Even in a medium-sized studio theatre it is likely that most practical fixtures will need some help from the lighting rig to look 'natural'. This can come in two ways. Traditionally, lanterns from the overheard rig are used to mimic the 'splash' of light created by the practical fixture. What can work better sometimes is modifying the practical fixture to create its own 'splash' at a suitably increased intensity. Care needs to be taken to make sure that the practical does not become a source of glare for the audience, and that the increased heat that often comes with higher-intensity sources does not create its own problems. That said, if the 'effect' of the practical is actually coming from the practical, then no one can disrupt the illusion. What we can do for the melodrama is to replace the domestic lamp-holder and shade of the standard lamp with a thicker fireproofed shade and stronger lamps. For example, a new shade can be built round a central disc with, mounted on the disc, above and below, a number of fittings to take the MR16 lamps found in birdies, and suitable transformers. The MR16 lamps come in a range of beam angles and wattage so the size of the 'splash' can be determined by the number and type of lamps used. Provided the shade is tall enough and thick enough to hide the direct sources from the audience, this can be a successful solution.

Making choices and drawing the plan

Let us assume that as LD you have gained a good knowledge of the space in which the performance will take place, whether by visiting the venue or from a careful study of the ground plan and section drawings, or from study of the virtual space created within a lighting design package such as Vector Works or WYSIWYG. You should have a grasp of the potential angles of incidence and throw available from each hanging position to each part of the stage, and be aware of where on-stage light from each hanging position can shine. You should ideally also have a good knowledge of what equipment you have available and what it will be able to do. And remember this is on top of your detailed understanding of the piece gained from extensive research and discussion with the other members of the creative team. You have already made some decisions about what kind of light should be coming from where at the key moments

[18] The term 'practical' in this context refers to light fittings that are part of the setting. In our show this is just the standard lamp, but it could be desk lamps, chandeliers, wall lights, or even a torch. Usually the actors will at least appear to switch them on and/or off, though to make things more reliable light switches on stage are usually dummies, and the lamp(s) are controlled directly from the lighting console.

of the piece, and now we have to start drawing the lighting plan.

Creating the lighting plan

In an ideal world, this whole process of consolidating the lighting needs of the production into a wish list for the lighting rig would perhaps take place in the performance space. The designers and production chiefs would walk through the space discussing the balance between aesthetic and practical, between what design would like and what production can achieve. Without that luxury, it can be hard to visualize the three-dimensional space represented by the two-dimensional drawing – but out of practical necessity that is what most LDs must do most of the time.

CAD or hand-drawn?

We have already touched on the pros and cons of these two different ways of presenting the information. In the next chapter, there is more information on what should be included in a full production lighting plan, and how that information can be best laid out to enable unambiguous assembly of the lighting rig by the production chief and crew. That process is about communicating information to others. What we need to do now though is to enable the LD to make the choices required to assemble the rig and afterwards light the show. The lighting plan we produce at this point can be quite sketchy. It is going to be used to help us advance the design ideas and make choices, and not yet to realize the lighting system.

Get your basics in the right place

By this point in the process, the LD should be fairly clear about what are going to be the basic elements of the rig. For most drama for example, this will include light for the actors' faces. For anything with a big cyc, getting that lit right will also be important. For almost any piece involving dance of any kind, the rig will need to contain elements that can be used to enhance the three-dimensional form of the body. For productions that enable or require the lighting to make grand statements, it will be important to get the elements that do this in the right positions. Whatever the priorities are for your production, the units that enable this will usually be the ones you want to place on the plan first.

Top masking to hide the rig: borders

The conventions of most European and North American theatre dictate that the majority of performance light will come from a rig above the performance space more or less hidden in the auditorium. For our melodrama, it is likely that we will want to hide as much of the rig as possible with borders above the stage. Very often the first thing we have to do in preparing the rig plan is position those borders. We will need to get a section drawing, which includes the 'sightline' from the front row of the audience. The 'sightline' on a plan or section indicates what an audience member can and cannot see. In Figure 11, a person sitting in the front-row stalls can see everything upstage of the borders *below* the green sightlines. Anything behind a border and above the sightline for that border is hidden for that audience member.

It is quite usual for the production manager to tell the LD which bars can be used for lanterns and which will be used for masking. Whenever there is a need to have a lighting bar (or other means of hanging a fixture) in a certain place, the LD needs to let everyone know that as early in

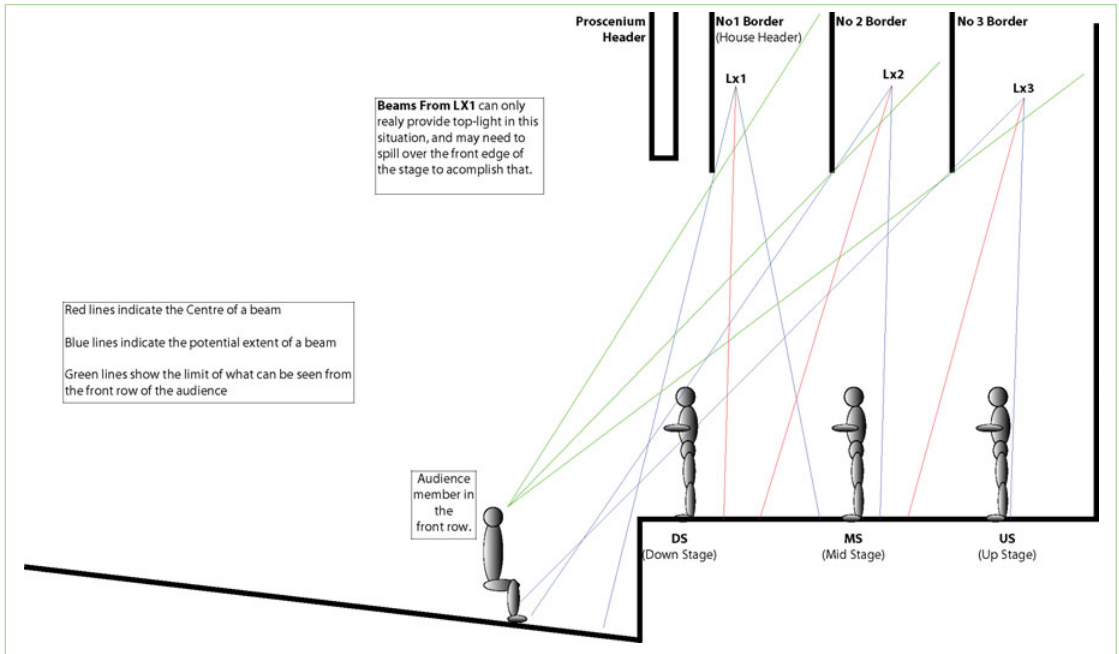
Proscenium Header
No1 Border (House Header)
No 2 Border
No 3 Border
Lx1
Lx2
Lx3
Beams From LX1 can only realy provide top-light in this situation, and may need to spill over the front edge of the stage to acomplish that.
Red lines indicate the Centre of a beam
Blue lines indicate the potential extent of a beam
Green lines show the limit of what can be seen from the front row of the audience
Audience member in the front row.
DS (Down Stage)
MS (Mid Stage)
US (Up Stage)

Figure 11 Stage masking is always a compromise. The downstage extent of back-light beams from LX2 and LX3 is limited by the borders downstage of each bar. The position of these borders has been set to make sure that the audience cannot see the lanterns (see the green lines). It is normal to avoid shining back-light into the eyes of the audience unless you want to create a distracting glare.

the process as possible. Downstage of each lighting bar is a masking border. There will need to be a suitable gap between the two to make sure the hot lanterns do not burn the masking, and to make it possible to focus and use the fixtures. The borders hide the lanterns and provide a clean finishing line to the top to the frame of the stage picture.

It is not always necessary or desirable to use borders to mask the lighting rig – sometimes we want to expose the rig as we have said before. When borders are used, it can be difficult to place back-light and front-light on the same bar or pipe, and hard to make full use of moving lights. Even when borders don't mask the rig, they are still useful to mask other flown objects (such as scenery) and remove distraction. For many shows with a lot of moving lights overhead, the borders mask the hanging position (and all the potentially messy cable) while allowing the moving light to move be seen – and to 'see' as much of the stage (and perhaps the auditorium too) as the show needs.

Once the positions of the LX bars and borders have been determined, we can start to consider what lanterns should go where.

Daylight scenes will be keyed with light – that at least appears to come through the window. If we want to indicate moonlight outside, we might get away with dimming the same tungsten fixture(s) down and using the decrease in colour temperature along with the decrease in intensity to signify moonlight, or we might put a colour changer on the unit(s) or even ask the crew to

change the colour manually.[19] Equally, we might want moonlight to have its own instrument(s) especially if we plan to use moonlight in some symbolic way, or to reveal something specific onstage.

When the apparent light source is the standard lamp, we want a more or less three-quarter back-light from upstage right. This needs to be coloured to signify light from a domestic light – comparatively low in colour temperature compared with the 3200 degrees Kelvin of most tungsten filament stage light. We could use filters designed to shift daylight down in colour temperature to stage light. These can work to shift stage light down in colour temperature to domestic lighting. Alternatively, we can use high wattage sources and run them at no more than 70 per cent of full, which will have a similar effect. In a situation with very few dimmers and not much equipment, we might make do with elements of the back-light wash, perhaps adding colour changers to some or all the units to create a warmer feel than the 'night-time blue'.

Maximum brightness and power?

Brightness onstage is largely relative, unlike lighting for camera, when very often minimum (and maximum) light levels need to be within a given range as measured by a light meter. The human eye can rapidly adjust to a far greater range of intensities than most cameras. For clear and detailed observation of moving performers we do require a certain minimum level of light onstage. Having said that, most often, getting the right balance between the range of intensity available to you from each element of the rig is more important than any minimum or maximum measurement of intensity onstage.

The maximum level of light we can get out of a lantern is very closely related to the wattage of the light source. Of course, we need to compare like with like – incandescent lamps, like those in most older fixed lanterns, produce less light per watt than the discharge lamps in many moving lights. LED fixtures are much more efficient at turning watts or electrical power into lumens of intensity, and at the moment many are described as 'equivalent to an incandescent lamp' of a certain wattage.

If you want your key light to be brighter than the fill, and both are from similar fixtures, you will probably need the key-light fixtures to be of a higher wattage than the fill ones. The same goes for specials you intend to use to cut through a wash (or general cover).

If we use a fixture with an incandescent tungsten-halogen lamp, it will have a different colour at or near full intensity than when it is at a much lower intensity. This is due to the drop in colour temperature of the cooler filament running at less than 100 per cent (see Chapter 2). Many Fresnels and PCs lose definition and beam size at lower intensities.

If you are lighting a show in an unfamiliar space, ask what size of units previous LDs have used. If that's not possible, or if you are about to use some new technology and you can't compare that to what has been used before, you might want to start doing some calculations. Most lantern manufactures publish photometric data sheets for their products. From there you

[19] This is not as uncommon as you might think. If space (or the budget for kit) is tight, and all the daytime scenes happen before an interval while the evening scenes happen after the interval, this could be the best approach.

Table 1 Photometric data for Source 4 profiles, with 230-volt lamps at full supply voltage (issued 14 November 2000, ETC Europe Ltd)

Lens (in degrees)	6m Throw		9m Throw		12m Throw	
	Approx. diameter of beam	Max lux on stage (750W lamp)	Approx. diameter of beam	Max lux on stage (750W lamp)	Approx. diameter of beam	Max lux on stage (750W lamp)
19	2.5m	5167	3m	2296	4.1	1292
26	2.8m	4000	4.2m	1778	5.6m	1000
36	3.9m	2336	5.8m	1038	7.8m	584

In most situations on stage, 5000 lux would be considered bright while 500 lux would be pretty dim. In a large auditorium, follow-spots might well need to produce around 10,000 lux onstage, while in a small studio theatre, where no audience member is more than 6m from the stage, the average state intensity of stage might be less than 200 lux.

should be able to find out how many lux[20] you can expect for a given lantern at a given throw. If you are lighting for broadcast quality video cameras you will have to really get to grips with using these tables. Once you have a feel for how much light you can get out of some fixtures you are familiar with at a distance you know, all you really need to find out is roughly how much more or less bright other types of fixture will be at the distances you are currently working with. (Remember that all manufacturers' figures will be for clean and well-prepared lanterns. That might not be what you have.) Table 1 shows some numbers from ETC for some of their Source 4 profiles.

This show is likely to be relatively dark – it is set entirely in an interior, and we will be playing in a small theatre with around 250 seats. We need the sunlight key to be quite bright, so we might go for a 2kW Fresnel or equivalent. The moon-light key on the other hand is only going to be used for 'night-time' scenes, so a 1.2kW unit might be appropriate here. Having decided on the power for the key-light fixtures creating the light from the window we can decide what power the units making up the supporting washes need to be – probably between 650W and 1000W.

One other factor that we might have to take into account is the relative size of units with different power consumption; generally, the higher the wattage the bigger the unit. This can mean units with different power hanging from the same bar ending up at different heights. We could find that the 2kW Fresnel is longer than the 1.2kW units that fill the rest of the LX3. If we have to trim the border a little lower in order to mask the 2kW, the 1.2kW will not be able to see as far downstage as we (may be) planned. This is an area where the advice of an experienced chief electrician or production electrician can be extremely useful. They are likely to know the relative sizes of units and can tell you if your chosen combination of fixture types will create problems.

More on choosing colours

Many professional LDs stick to their base of favourite colours through the years. They might try out one or two new ones each show (or for the

[20] Or foot-candles if you prefer. As it happens, 1 lux is very close to 10 foot-candles.

more cautious, each year) and slowly over time change or broaden their palette. The reason behind this may be innate conservatism, but it may also tell us something about just how hard it can be to get colour right in performance lighting design. Once you have a few colours that you know work well together on most facial complexions and with most costumes, why throw that away and start afresh every show? We have already mentioned several times how dimming tungsten lamps changes the colour of the light onstage, and understanding how this works for your favourite colours is important too.

Drama lighting – especially for faces – generally uses tints and subtle colours close to the white light we are used to seeing in nature. We know that responses to colour are subjective from person to person, and to some extent from culture to culture, so it can be counter-productive to rely on coloured light for too much signification. Also, whenever any one element of the performance design tries to do too much, things generally go wrong. If the set designer and director have agreed with the painters or costume makers on the colours of costume and set, what purpose does the LD serve by flooding the stage with coloured light, changing these carefully chosen colours?[21]

In some circumstances, the design team may agree on the use of strongly coloured light, and when this happens it can be the signal to go into parts of the colour swatch book you have previously not explored. Choosing colour for a lighting rig is often a really big deal. If you get it wrong, even on a relatively small scale, replacing colour can eat up budget and take time away from potentially more useful work. Getting it wrong on a large-scale show can be a nightmare! But this knowledge should not stop experimentation; indeed it should encourage you to try out colours and colour combinations before deciding on what colours to use in your rig.

Samples and swatch books

Back in Chapter 3, we discussed some of the implications of using coloured light on stage, mixing complementary colours from each side of stage to create something close to a neutral white light where the sources overlap for example. We would use this idea when it comes to choosing colours for the three-quarter front-light for the melodrama, and for the pipe-ends too. We need to make sure that whatever choices we make the resulting colours will work with the colour choices of the set and costume, of the performers' faces, and of any special make-up that is proposed. Try to get hold of samples of the materials to be used, and shine your chosen coloured light on them in an otherwise darkened space. (It does not have to be a dark room, but beware of direct sunlight and fluorescent fixtures, as both of these can affect colour perception.) Make sure you use a source close to the same colour temperature as the fixtures you will be using on stage; for example a good-quality task-light with a tungsten-halogen bulb, or a mini-fixture such as a birdie (also called a PAR 16). A standard anglepoise or study light is probably not suitable, since it is likely to have a lamp with a much lower colour temperature. Do not use LED torches for sampling colour unless you propose to light that material with LED light.

If you have access to the model box, try out a few different colours in that – using a couple of

[21] Of course, sometimes when elements of the set or costume appear onstage the colours don't 'work' for the production team and it falls to the LD to 'do something about it'. But that is a different situation.

torches and samples from a lighting filter swatch book. If you can get to the costume workshop, take down your QI torches and the lighting filter swatch book. Better still, take a small lantern and a power adaptor so you can plug it in at the workshop. You will need slightly larger 'gel' samples, but you can often get hold of off-cuts from a theatre workshop or a hire shop. You can then try out different colours of light on the fabric that will make up the stage costumes, which will help you chose colours that everyone is going to be happy with. You can (and should) do the same thing if you can get to the space where the set is being painted, where large props are being made, or where special effects are being created. Apart from the knowledge you will gain about how the coloured light will affect stuff onstage, you will be meeting with some of the other people who will contribute to making the performance and perhaps getting new angles on the piece (and making new friends). The more stuff you try out before you get into the performance space, the more likely you are to be able to realize your creative dreams.

Concert rigs: structure as part of the visual design

The expectation of lighting for live music concerts and festivals is quite different from that of our little melodrama. As we noted earlier in this section, the expectation for the melodrama is usually that the lighting rig will be hidden from view. For many live music concerts, the lighting rig is not only not hidden, it often forms a major part of the structural scenography on stage – the lighting rig itself as set. But how much does this change the process of deciding what units go where? There will be the same considerations of how to make the washes, and where to place the specials, the same calculations concerning beam angles. Even if the majority of units in the lighting rig are moving lights, these calculations will still be needed: How many MACxs or VLys units from which position will I need to wash the whole stage? What beam angle of front-light unit will work as a special for the backing vocals or the drummer?

Two things are very different. The first we have already touched on, and that is that the shape of the lighting rig – the impact it has as a structure – is important. This often means the LD and set designer work closely together to come up with a visual concept that defines the space of performance. These days there will usually be a media designer involved too, who will need screens or other display surfaces incorporated into 'the look'. Just as with the melodrama, only after a shape has been agreed on does any work begin on placing lanterns. The difference is that it is much more likely that the LD will have had a major say in what that shape is.

The second difference is that almost all design for live music has to take into consideration touring. It is quite normal for several large trucks to turn up at 8.00 am outside an empty concert hall, for those trucks to be unloaded, the equipment assembled, flown, powered up, focused and sound checked in the following seven to eight hours, for the concert to happen at 8 p.m., and for the hall to be once more empty by midnight, all the equipment back in the trucks and on the way to tomorrow's venue. This has an impact on what can and cannot be part of the lighting design. Everything has to be modular, from the truss structures that support the lights, to the set elements, to the cabling and dimmer systems. And every focused unit has to be able to be ready in time for the show – no long hours spent getting each wash perfect; this is 'big brush' stuff, with the minimum of subtle 'hard to achieve' effects.

Both practices have something to teach the other. The few practitioners who move comfortably between the two ways of working produce some

of the most visually stimulating work around – for example Patrick Woodroffe, LD for The Rolling Stones among others, and Bruno Poet, who has won awards for lighting opera, drama and musicals, as well as for lighting the band Sigur Rós. If drama lighting is often about attention to detail, rarely demanding overt signification by light, concert lighting is often about scale and ambition and big statements – with lighting as a major signifier, providing overt content.

The lighting plan: an evolving document

Back thinking about the stage of our melodrama, the first draft of the plan is just about complete. We have our big keys – one for the daytime scenes and one for the lamp-lit evening scenes. We have several systems of face-light, and through experiment in the wardrobe department, and at the set painter's workshop, we have chosen the colours for these. We have other systems and specials and practical fixtures being made in our workshop for the fireplace and the standard lamp. In short we have enough information to allow the chief electrician or production electrician to assemble the bits that will go into making our rig. Each decision that has had to be made has involved combining information from several sources: dramaturgical information concerning the effects we want to create onstage; technical information, for example concerning what different lanterns will do; and practical information, for example the relative positions of LX bars and the set. We have had to do several scale drawings, and we have made a new tool. At times it has been hard to resolve conflicting demands, but we have produced a lighting plan!

Then the production manager tells you that the position of the number 3 lighting bar he gave you was wrong, or the budget is not big enough to hire all the lanterns you want, but that the theatre has found some (old) ones in the cellar! It won't always be like that but sometimes it will and changes will happen. As LD you need to stay on top of them, keep your team informed and try your hardest to keep the plan up to date. All this at the same time that you are going to rehearsals, talking to the director and other designers, establishing relationships with the stage-management team and the performers, and keeping your cue synopsis up to date. Well, nobody said it would be easy!

It is most unusual for the lighting plan to remain unchanged from its first inception through to opening the show in front of an audience, whatever the genre and whatever the scale. As LD, your work depends on this document, and you need to make every effort to ensure the current version is accurate and that everybody is working to the current version. But you will need more than just a lighting plan to get your rig up and your design onstage.

7

Plans, paperwork and patching

Good documentation aids good lighting design

Getting the lighting equipment suitably prepared, in the right place, connected to the right dimmer, power and control cables, and patched to the lighting console, is what enables the LD to create performance lighting. Achieving this happy state as quickly and as accurately as possible requires planning and communication. For any production that needs more than one or two people to set it up, good paperwork becomes an essential tool. Who produces the paperwork, and who keeps it up to date, depends on local custom and practice, and many other factors. Sometimes the LD will produce it all. At other times, the production electrician (master electrician in North America), house chief electrician and the design associate will each produce parts of the paperwork.

Getting it right, and that includes making it easy for all concerned to use it, is a vital part of getting the lighting rig in place and working on time. Achieving this important goal means more time for the lighting designer to create cues, and for the rest of the production, including the performers, to rehearse the show ready for the audience. Let's face it, whether it's a village hall drama, a West End or Broadway musical, or a concert tour, making the best show we can for the audience is what it is all about.

In part to keep this chapter at a manageable length, I am making the distinction between the documentation required to get the lighting system in place and working, and that required to focus or point the instruments and to build the cues that make up the design. I will come back to these later documents in the next chapters.

The lighting plan or plot[1]

To realize most lighting designs, somebody draws a lighting plan. It may be drawn on a computer using a two-dimensional drawing program or a full 3D computer drawing package, or a drawing board with pencil, stencils and ink, or on a scrap of rough paper with a ball point pen. It might be drawn by the LD, their assistant or associate, the production electrician, a specialist from the lighting hire company, or the chief electrician

[1] European practice tends to use the words 'lighting plan' (in English and some other languages) while North American practice uses 'light plot'. Both usually refer to an idealized or schematic view of the lighting rig from overhead. The generally understood meaning of 'lighting plot' in UK theatre is of a record of the lighting cues.

or lighting manager in a repertory theatre. There is no generally accepted format, though it is clear that some layouts work better than others, and different situations require different types of lighting plan, with different levels of detail. It should be about the efficient unambiguous communication of information, but that is not to say it can't look good.

It is important to acknowledge though that the lighting plan or plot *is not* the lighting design – it is one of several tools required to get that lighting design realized.

What goes on a lighting plan?

It is usual to include an obligation to produce an accurate lighting plan in the contract of a professional LD. Very often, the LD only becomes entitled to part of their fee once the lighting plan (and quite possibly some supporting paperwork) have been delivered.

In the build period of a production – generally the time between handing over a (more or less) final lighting plan and before the first technical rehearsals with the performers – there are at least four distinct users of the information the plan and associated documents should contain:

- On productions with a substantial lighting system there will normally be one person in overall charge of getting the rig up and working. That person might be called chief electrician, head of lighting, or the production electrician.[2] They will need to know weights, colour materials and gobos used, fixture addresses and modes, and many other details of the rig. They will usually also need to plan how each fixture on the rig will be powered and controlled. This is called patch information.
- If the rig is to be hired, the hire company staff will need to know how many fixtures of each type to bid on, and then to prepare. They may also take responsibility for assembling all the cables and other ancillary equipment needed (anything from colour frames to power and signal distribution equipment).
- On all but the simplest of fit-ups, the people hanging the fixtures will need information to help them get each fixture in the correct place, plugged to the correct socket, and with all the correct ancillary equipment properly in place. This includes the final height of lighting bars and trusses, and enough information to position and rig such things as booms and ladders.
- When focusing and/or creating cues, the LD may use the lighting plan to find the channel and fixture numbers, group names and other information.

Versions of the lighting plan may also be required as part of the documentation of the show, for touring, for maintenance during an extended run and for possible future re-presentation.

Here are some features that should appear on every lighting plan:

Titles: What is the show? Is this the drawing for a particular version of the show (e.g. the US tour, or the London opening)? If the drawing relates to a specific venue, this should be clearly stated.

Drawing type – **lighting plan**: Does the drawing include everything, or are there more drawings of detail from, for example, lighting inside a scenic truck or practical fittings on the set, or fixtures rigged on the ground that if included on this plot would make it less intelligible, or audience lighting for a large live music tour?

[2] Of course, on small shows, it might be the LD themselves.

Date and version number: This is very important, especially when working on a production that is still changing. Everyone involved needs to know they are working from the same, up-to-date information, and this is one of the best ways to make sure they can check that. Anyone who makes alterations to a drawing will need to alter these information fields too.

If a drawing is based on a ground plan it is a good idea to make clear the ground-plan date and version number that have been used.

Whose plan is it? It is important that intellectual property, in this case the lighting design that is, in part, represented by the drawing, is acknowledged and protected. All drawings that are part of a design need to acknowledge the designer. A performance lighting design is part of a larger thing – the production – so the other intellectual property holders also need to be acknowledged: the director, the other designers, and perhaps the writer and producer.

The venue: Generally, the whole production will be constrained by the walls, doorways and other architectural features of the venue. The edges of the performance space, the extent of any spaces 'offstage' and hidden from the audience, and where the audience will be, all have an impact on the implementation of the lighting design. In a proscenium theatre, the location of the proscenium arch is clearly important too. For a show that uses the production infrastructure of the venue – hanging positions, follow-spot booths, and so on – these too should all be clearly marked.

Main features of the set: The position of the lighting fixtures will to a large extent be determined by the position of the set. The set often also defines where the performers will be and so further determines the position of lighting fixtures. A ground plan showing the set will often be the base on which the lighting plan is drawn. However, it will normally be necessary to show the set 'in the background' to the main content of the lighting plan – that is the lighting rig. This can be done in a number of ways by using thinner lines or paler colour, for example. Productions with more than one set will need to clearly label the lines indicating set positions at different moments during the piece.

Heights: In an ideal world, any 'plan' drawing should be accompanied by a 'section drawing'. In a plan view there is no difference between the line representing a lighting bar 3 metres above stage level and the line representing a lighting bar 12 metres above stage level – *unless we label them*. Convention uses the stage floor as a reference height of zero, so an object ten metres above stage level would be labelled +10m, an object or area one metre below stage level would be labelled −1m, and so on.

Contact information: This may not be explicit, but it needs to be there. As someone using the plan, who do I contact if any information is unclear or something needs to be changed? The LD's name is already on the plan. The person who drew the plan needs to put their name on it too, and for a large show so might the production electrician or other front-line person.

A key and legend: Fixtures and other equipment are represented by symbols on a lighting plan. The key allows users to know precisely what each symbol represents. The legend should also make clear the meaning of each of the many numbers that appear on most lighting plans. (See also notes on the key in the boxed section.)

Scale: This defines how much linear distance on the stage is represented by each unit of measurement on the plan. European plans are generally in metric scales, 1:25 (one centimetre on the plan

represents 25 centimetres onstage), 1:50 and 1:100. US plans are usually in imperial scales, 1:24 (one inch to two feet) or 1:48. Measuring distance on a plan of any kind is best done with a **scale rule**. This is a ruler that is marked with the dimensions in 'real space' for a particular scale. For example, a 1:25 scale rule will have metres marked off every 4 centimetres along its length. Most scale rules have more than one scale – for example a flat scale rule will have at least one scale on each edge and usually this will be repeated on the underside. Always check the scale you are using is correct for that drawing.

Some plans include detail drawings in a different scale, for example drawings of an unconventional hanging position. These parts should have a definite border and be clearly marked with their own scale.

If you are not sure how your plans will be copied, it is a good idea to include a **scale bar** in the drawing. This can then be measured by the user to check the scale is correct, and to compensate if it is not. Many plans include something like '1:50 when printed at A1', which can be useful too.

A border: This is the continuous line framing the plan, about 2cm inside the edge of the paper. This may sound odd, but particularly for digitally produced drawings, it helps assure users that they have the whole drawing and that it has printed out correctly. Including a scale bar in this border automatically produces an accurate scale rule that can be used no matter how the plan is printed. Borders can also help when taping together a large plan printed on several smaller sheets, something that often happens when large format printers are not available.

Software title and **version number** (computer-generated drawings only): This is particularly important when the plan file is sent to other users. It is possible to open some lighting plan files in programs other than the ones they were created in. This may result in information from the original drawing being lost, however. The same can happen when opening a file in a different version of the program, or when two users have different ways of creating or printing a drawing. By far the safest way to ensure that what is sent by one person is what is printed off by another is to use the Portable Document Format (PDF) from Adobe when sending plans electronically. Even though this loses associated information, and leaves the receiver with an un-editable file, do not assume any other method works until tested several times.

Load-in date and/or **focus date** or any other important date in the production schedule: Those preparing the equipment need to know when it has to be ready and those working at the venue need to know when they have to be ready.

Finally, **the lighting rig**: This is a schematic representation of every fixture in the lighting rig, the structures they are rigged on and other items of equipment that will be needed to realize the lighting design. Each hanging position needs to have a trim height[3] label as previously discussed and, as we shall shortly see, a name.

The set ground plan

In previous chapters, I wrote that the set ground plan is an important starting point for the LD

[3] Trim height is usually the distance from the stage floor to the bar or pipe with the lanterns, etc. on. For trusses, trim is usually to the lowest 'chord' – or load baring member – of the truss. (See later diagram of a truss for further detail.)

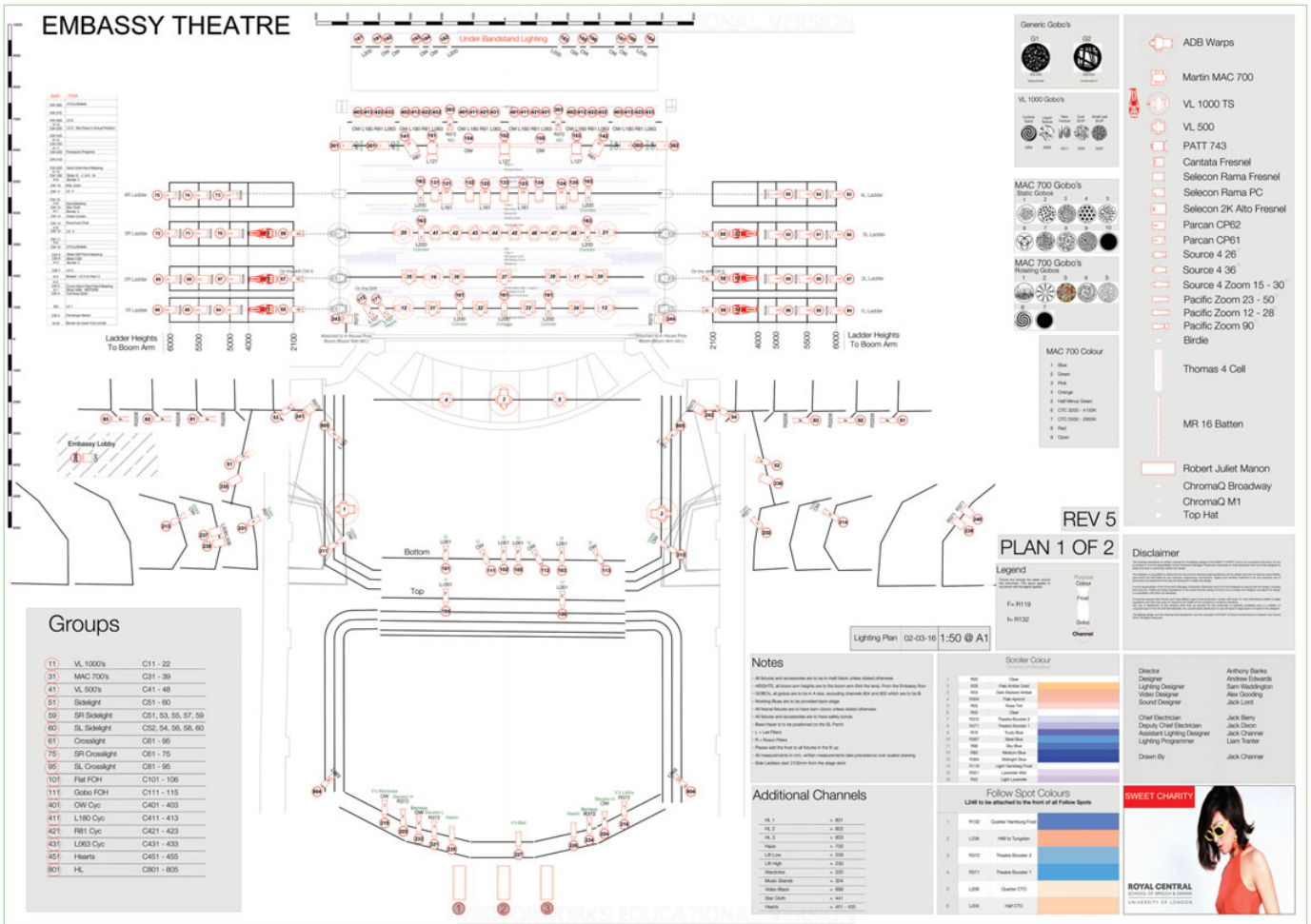

Figure 1 This is the LX plot for *Sweet Charity* at the Royal Central School of Speech and Drama. It contains a great deal of information for the LD and the chief electrician. In addition to the fixtures rigged on lighting bars over the stage and bridges over the auditorium, a number of fixtures are rigged on flown ladders and fixed booms. Where the height is given for these fixtures it is the height to the rigging position. This is unusual. It is standard practice to give the height to the lens of the lantern and let the production team work out where to put the rigging to get the fixture to the right height.

when they come to deciding where to place the lighting instruments. Almost all lighting plans are based on a set ground plan. There are very good reasons for this, such as:

- The set most often defines the space of performance and therefore the space that needs performance lighting.
- The set ground plan and section(s) indicate potential playing areas, locations of audience focus, boundaries and potential obstacles – all of which will need to be considered when deciding where the lighting instruments need to be placed.
- Lighting instruments and equipment cannot occupy the same space as elements of the set. Basing the lighting plan on the set ground plan helps to ensure everything gets its own space.

The set ground plan often does not include the whole of the performance space – for example the auditorium of a theatre. It is likely that the LD will want to place equipment outside the area on the set ground plan so a plan that shows the set and the whole space, with all the potential hanging positions and production infrastructure, will be needed by the LD and their team.

Deciding the level of detail

Exactly what kinds of detail are included will depend on who the drawing is intended for. For example, the hire company is unlikely to need to know the same information as the LD, or the production electrician, or the local authority licensing officer. No doubt each user could work from the same basic plan, highlighting the information they need, and ignoring everything else. The better computer drafting programs, however, allow several different drawings to be made from the same information, each one tailored to the needs of specific users.

Take as an example a medium-sized live music tour – say a two- to three-truck tour playing one-night stands in large theatres and sports halls. The lighting plan is likely to have been produced using a computer drafting package. There could be several drawings of the lighting plan, each showing a different level of detail for different users. The rigger, responsible for suspending the trusses that will hold the lighting equipment, will require a plan that gives the weight of each truss, the load exerted on each of the suspension points and the location of each suspension point relative to a known datum point (often the centre-stage point at the front edge of the stage).

The person responsible for planning dimming and distributing power will need a drawing showing all the lighting fixtures, and providing enough detail to allow cable lengths to be calculated. This drawing will show the circuit details and the address of each fixture, to enable full preparation of the system, and to help with locating and fixing faults. It should also show the trim height of all bars or trusses, and the intended route for cables connecting the fixtures in the rig to the dimmers and power distribution. This drawing is usually the one with the most information, and can be hard to read at first. Often the information is more usable when presented in table form.

The production manager, responsible for fitting the show into each venue on the tour, will need to know overall dimensions of the production. They will also need other information such as the equipment schedule and how much electrical power is going to be needed, but will not expect to have to get that from a plan. The production manager will be interested in having

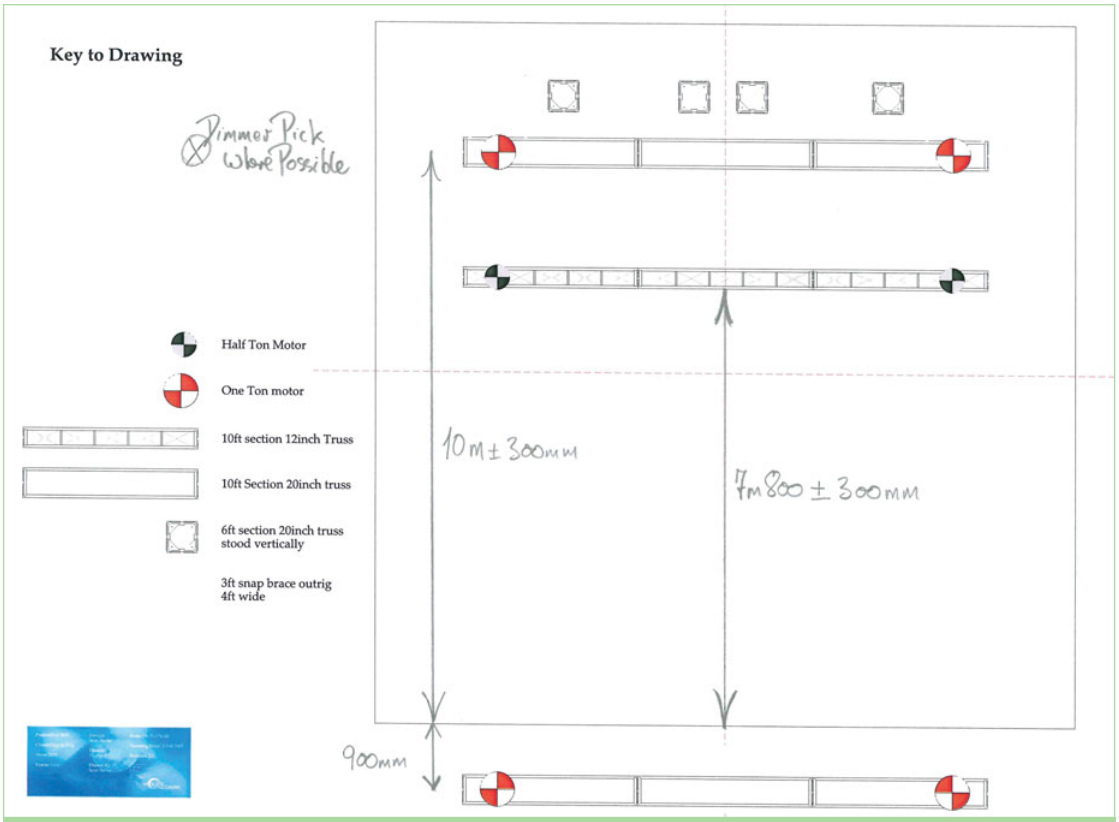

Figure 2 Seal tour rigger's plot with working amendments showing hanging point layout and weight loading – not a lighting fixture in sight.

information in an appropriate form for the use they need to make of it, the dimensions in graphical form and the rest in an easily accessible spreadsheet.

The LD and the lighting programmer require a drawing that shows the schematic location of each fixture, any colour filter used and every channel number, that is the number that when typed into the lighting desk will activate the fixture. They need to be able to access each fixture as easily as possible. Though they may quickly become familiar with the layout of the lighting rig, at first they need rapid access to control numbers. Their drawing need have little or no additional information.

Hanging positions and unit numbers[4]

It is useful in any lighting rig to have an unambiguous 'name' for each fixture in the rig – a unique identifier. The most commonly used system is to name each hanging position, and then number each fixture in that hanging position from an agreed starting point, say the

[4] Also known as fixture numbers.

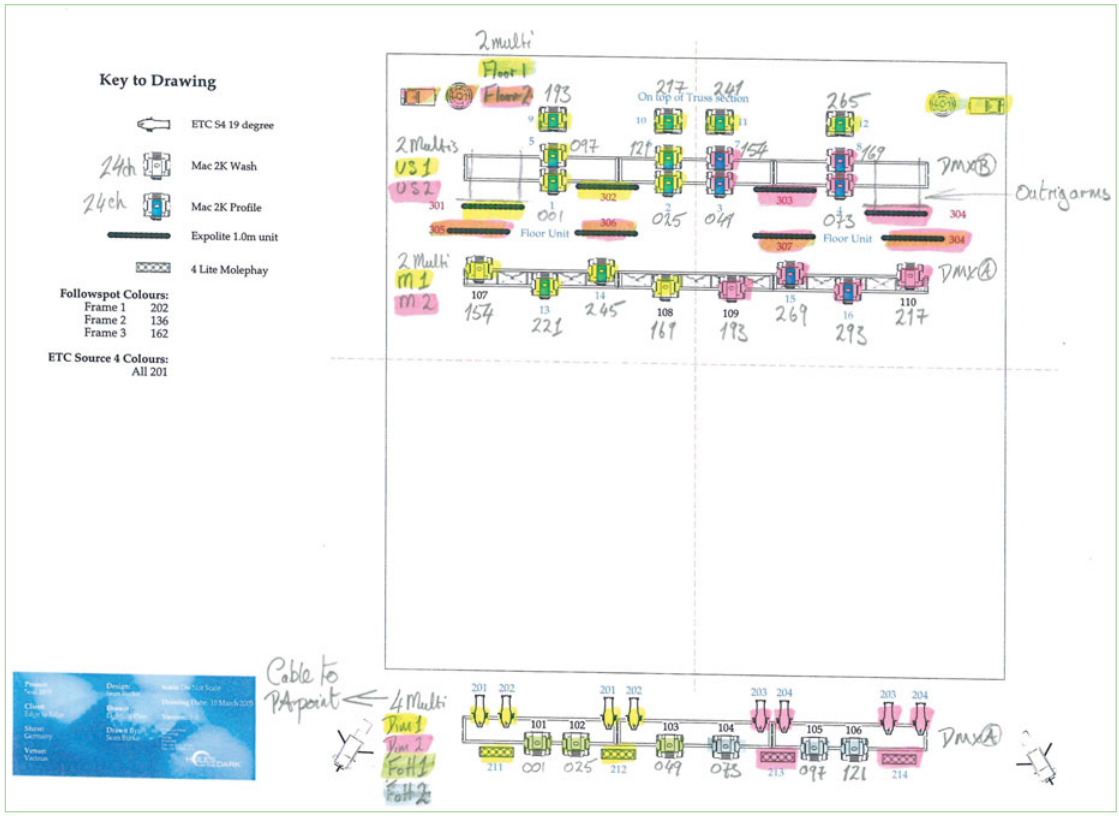

Figure 3 Seal tour lighting plot showing annotations made by the person planning the power and control side of the rig. Included here are DMX and channel numbers, cable routes and dimmer position.

stage-left end of overhead bars[5] and trusses, and from the top of vertical bars and trusses (booms).

Conventionally in theatres, the bars used for lighting are numbered in from the proscenium arch towards upstage, that is LX 1 upstage of and nearest to the proscenium. Moving out over the audience (downstage from the proscenium) lighting positions often have names peculiar to the space. Closest to the proscenium is usually called the advance bar. Concert touring systems tend to follow these conventions, with the most downstage cross-stage trusses being number 1 and a position over the front of the audience being an advance truss.

Vertical rigging positions at the side of stage, in theatres called boom positions, are usually numbered using the same conventions, number 1 nearest the proscenium. They also take a name from the side of stage they are on, stage right or stage left. 'No. 1 SL boom' is the most downstage on the stage left side. One frequent exception is the proscenium boom. Many theatres have a built-in position usually attached to the upstage wall of the proscenium, called the prosc. boom. This may or may not also be called

[5] Known as pipes in North America, and consequently in several drafting programs for lighting.

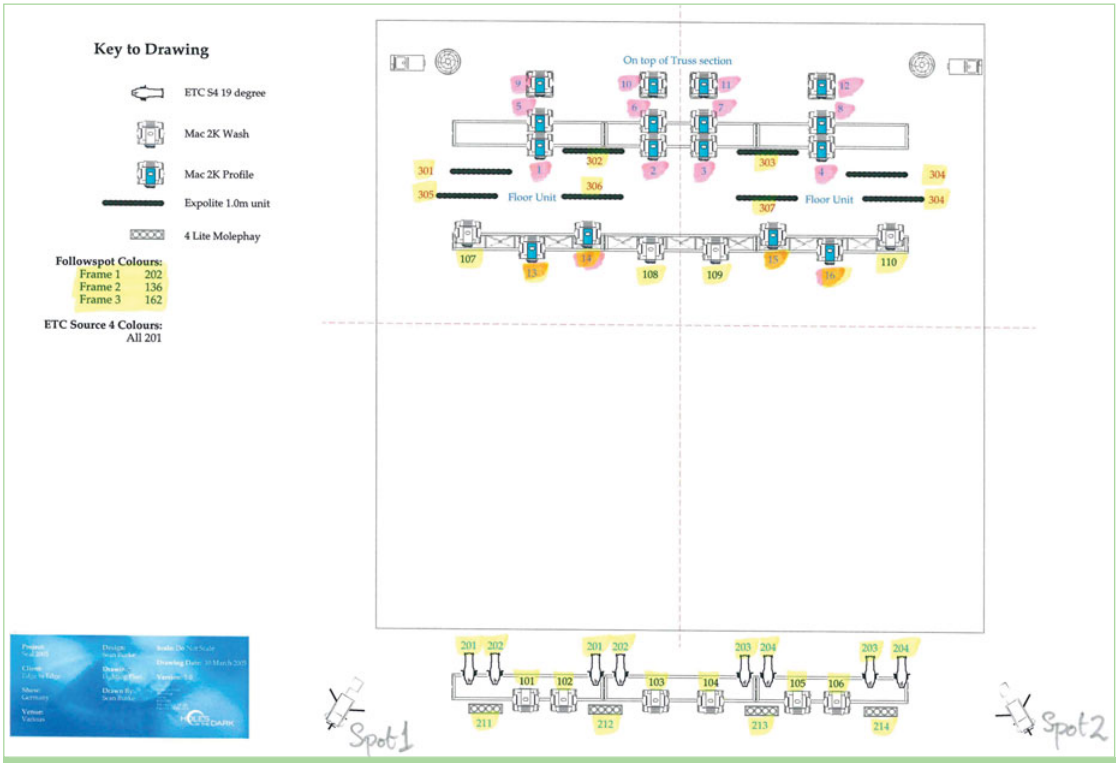

Figure 4 Seal tour LD's plot showing fixture position and channel numbers highlighted. Also highlighted are spot colours.

the no. 1 boom.[6] Also to be found immediately behind some proscenium arches are perches. These can vary from stubby remnants of an ancient installation to purpose-built platforms that include onstage follow-spot positions. In many theatres in continental Europe, these positions are very well equipped.

Some theatre front-of-house positions have already been mentioned, box booms and gallery booms – the high side positions that have been a vital part of many theatre lighting designs over the past 50 years – and circle fronts – good for getting light into the eyes of a performer, but problematic in other ways. Some theatre spaces have many others with names particular to that space.

Some more modern theatres and concert halls have lighting bridges front of house. These are usually numbered starting with the bridge closest to the downstage edge of the performance space and increasing towards the back of the audience space.

Many studio spaces, capable of being set up in a number of audience/performer configurations, simply begin numbering from one wall and try to keep as logical as possible. Spaces used in the round sometimes use compass points and levels as position names (top-west, mid-south-east, etc.)

[6] Occasionally the pros boom is on the audience's side of the proscenium, so it is worth checking.

or the names of adjacent roads or local landmarks to designate positions. The system matters less than agreement on its use.

Once each hanging position has a name, no matter how arbitrary, each fixture hung in that position can have a unit number – again staring at one for each position and ideally using the same convention throughout the space. Each lantern fixture now has a unique identifier – that is, it's hanging position and it's unit number – and so can be handled more efficiently in a spreadsheet or database, and referred to unambiguously by the whole lighting team.

Ways to make plans more readable

Except when the lighting system is of such a small scale that the LD is working without other technical support, patch information is best left off the LD's plan.[7] This is because once the LD is actually lighting the show, they will usually be working at a dimly lit production desk in an otherwise dark space. The LD will want to be looking at the stage for as much of the time as possible, so needs to be able to read channel numbers from the plan as quickly as possible. The most important pieces of information on the plan are usually the location of the fixtures in relation to the stage, and channel or fixture numbers needed for the lighting desk to change the value of attributes and make cues. Next comes the colour, gobo or other information that will affect the colour or quality of the light reaching the stage. Only when there is a fault discovered, and a lantern does not respond to the lighting desk, will it be necessary to know details of multicore and way number, dimmer number, DMX address, and so on. And this can be found elsewhere.

So the LD using a lighting plan to help in creating cues needs to be able to read channel information for each fixture quickly, under dim blue light, while possibly at the same time looking at a bright stage and the screen of several computer monitors! To achieve this, the outline and fixture number of each fixture needs to almost pop out of the plan.

Computer drafting vs the drawing board

Computer-generated plans have one great advantage over hand-drawn ones when they are linked or linkable to a spreadsheet or database program. This means that changes made by computer on the drawing are automatically made on the paperwork too, and vice versa.

Computer-generated plans have a few other advantages too. Chief among these are the ease with which copies can be made, the relatively low cost of using colour, the ability to send computer plans great distances by email and the ease with which different versions of the same plan can be produced from the same base information as we shall see. Colour can be especially useful in making a plan more readable. For example, multiple set positions can be drawn in blue or cyan; the lines will be clear enough under white light, but will disappear under the blue light of the production desk (when they become the same colour as the now 'blue' paper) leaving other information more clearly displayed.

Computer drafting programs use a concept called layers. Imagine a drawing board with three sheets of transparent drawing material on top of each other. If the venue is drawn on the bottom

[7] Many lighting designers follow North American practice and use cheat sheets rather than a plan, and we will discuss the pros and cons of this approach too in later chapters.

layer, the set on the next layer up and the lighting rig on the final layer, alterations can be made to each layer with no danger of affecting the other two. Also we can remove the set drawing or the lighting drawing to make the remaining drawings clearer. This is what programs like AutoCAD enable us to do, except that we can have almost as many layers as we like. We can select the combination of layers appropriate to each version of the drawing we require.

There are formal and informal standards for computer drawings, dictating for example line weights and line colour for the representation of various different objects. Layer names may also be defined. However, we must not lose sight of the needs of the immediate user of any paperwork produced. Most standards were developed for use on building drawings rather than for production drawings. Generally, you don't have to follow them unless they are useful.

Symbol vs picture

Each fixture type on the rig is represented on the lighting plan by a different symbol. To make things as easy as possible, it's a good idea to use symbols that resemble the fixtures. That way the crew are likely to make fewer mistakes. It is important to use symbols that accurately scale up to the same size as the fixtures they represent. If you were to use symbols that were smaller that the fixtures, it would be very easy to put more on the drawing than would fit on the actual hanging position. Many programs offer the option to use a detailed schematic drawing of the fixture or a much less complex outline drawing. While the detailed drawings can look impressive, they can also take longer to print out or to render on screen. I prefer to use simple outline symbols for lanterns, with the unit number discreetly *inside* the symbol, the colour in front of the symbol (in front being the side where the light comes out) and the channel or fixture number behind the symbol, close enough to the lantern to be unambiguous. This is not always easy with CAD drawings, especially when representing vertical structures. It is often necessary to play around with the way the attributes are laid out in the default symbols of CAD libraries to make the drawing work.

Layout: 'real' or 'idealized'

There are several conventions for representing vertical lighting positions on a lighting plan. Lighting plans for UK theatre usually aim to show the 'boom' or other structure as if it were laying down flat with its base on its correct position. If this takes more space than is available, sections of the boom where there are no fixtures may be missed out (using the standard 'missing section' line type). In any case, the height from stage of all fixtures should be clearly shown – using the same units throughout the plan.

Other ways of representing vertical positions include boxed drawings of appropriate parts of the section to each side of the 'overhead' plan drawing, or not including them at all in the plan, and instead using separate section drawings. In either of these cases, it is usually necessary to include on the plan drawing an indication of the horizontal position of all vertical lighting positions, and any other vertical features.

Many performance spaces include features that make them difficult to represent on a flat piece of paper of a manageable size. In some large theatres, front of house positions are a long way from the stage. If the plan were made to accurately show this, there would be a big empty space in the middle of the plan, and we would need to find extra-long paper, or use a smaller scale. The solution is usually to truncate

the horizontal distance to these positions to avoid 'wasting' a large central area of the paper. However, this means that we can no longer use the plan to draw the simple section we used in Chapter 6. If this practice is adopted, it must be made evident to the user. Imagine a visiting LD using a scale rule to measure from downstage to the 'upper-circle front' position on a plan with a middle part of the auditorium cut out for convenience. The plan has the height above stage level of this position, so the designer can sketch a section. Lanterns with a beam size that appear to work based on the distance from stage to the position *on the plan* are chosen and installed. When the LD turns up and discovers the mistake it may be too late to change the lanterns for more appropriate fixtures with a narrower beam. If the visiting production lighting person has not spotted the truncation on the auditorium space on the plan, he or she may arrive without long enough cables to get to these positions.

Another problem arises when we want to represent two lighting bars that sit above one another. If they were drawn above one another there would be confusion at best or an unreadable mess at worst. Common practice is to take the least important position and draw it in a box with arrows pointing to where it sits in the space.

I would ask anyone who needs to alter the representation of real space on paper to be aware of these kinds of problem. Most users would prefer a plan at a recognized scale, and printable on paper we can actually buy, and fit into a standard plotter or printer. Sometimes to achieve this, distances are shrunk and positions are altered. All potential users need to be made aware of this.

Instrument schedule/ equipment list

Once the plan has been drawn, on a computer or by hand, we usually need to break down the information about the lighting rig into table form. This is to make it easier to order equipment (fixtures, accessories and colour, etc.) and to allocate power, dimmer and control channels – that is to patch the rig.

Instrument schedule and equipment list are the North American and UK versions of more or less the same thing – a list of everything the production will use to realize the lighting design, hopefully arranged logically. As with the lighting plan, exactly who produces this document will vary from production to production. Table 1 is an example of an equipment list as it might be laid out by a production electrician or chief electrician going through a plan for the first time to put together a 'shopping list' for a production.

Patching the rig

Once the total number and type of fixtures required is known, the next task will help define the type and quantity of other equipment required to realize the lighting rig, including cables, dimmers and power distribution. This includes the process known as patching the rig. The allocation of a fixture or fixtures to each dimmer or circuit breaker is known as hard patching, while the allocation of control channel numbers[8] to each dimmer or group of dimmers is called the soft patch. Most lighting systems use multicore cables – large cables carrying multiple circuits. Power or dimming for each fixture is allocated to a particular way on a particular multicore. This

[8] Also known as handle number in some circles – this practice is taken from manual preset desks where each control channel had its own slider or handle.

Table 1 Equipment list 1: a first response to the plan by the production electrician

Fixture Type	Hanging Position	Unit No.	Lamp Type	Power (Watts)	Colour	Frame Size
A clear description of the fixture, including beam angle required and manufacture if specified by the LD.	*Helps with identifying each fixture in the rig, and to decide what additional equipment may be needed to rig the fixture; e.g. hook clamp, boom arm.*	*No. 1 is SL end of horizontal bars/trusses, and the top of vertical booms.*	*Many modern fixtures come with several lamp options so it is important to note this. Also the watts column can be 'summed' later to find out how much power might be required. To make this work properly, however, we need to use the same units for every entry.*		*These columns will give an experienced prod electrician a feel for how much colour needs to be ordered.* *Later, information from these two columns will help the Prod LX to assemble an accurate 'colour call' (see later in the chapter).*	
ETC Source 4 profile 36° c/w Gobo Holder	LX 1	1	Standard Life HPL	575	L202	170mm^2
8' Fresnel & Barn Door	LX 1	2	T11	1000	#53	180mm^2

Table 2 Equipment list 2: the beginnings of a patch sheet

Hanging Position	Unit No.	Fixture Type	Multicore/Way	Dimmer/Breaker No.	DMX address	Desk Channel No.
Together these two are a unique identifier for every fixture in the lighting rig		*Use the same abbreviations throughout*	*AKA plugging information; which socket in which cable spider or stage box or whatever is each fixture plugged to*	*Incandescent fixtures need dimmers, moving lights need hard power. One fixture per breaker is the ideal – more secure protection and easier to reset rogue moving lights*	*The digital address used by the lighting control system to access each dimmer or moving light.*1	*The number used to make the fixture respond from the desk.*
LX1	1	S4 Pro 36°	LX1A / 1	Rack 1 dim 27	1/027	101
LX1	2	8 inch Fres.	LX1A / 2	Rack 3 dim 14	1/114	31

means we can easily have at least five numbers associated with providing power and control to each fixture:

- **Unit number** and hanging position provide a unique identifier for each fixture.
- **Hard patch**: the dimmer number or circuit breaker number allocated to each fixture.
- **Soft patch**: the control channel number allocated to each fixture, the number which when typed into the desk will enable control of the fixture.
- **Multicore number (or name)** allocated to each of the large cables feeding several fixtures, so that we can distinguish one from the others.

- **Multicore way number**: the plug and socket number within the larger multicore on the *stage box* or *spider*.

It is easy to become confused about which of these numbers we are talking about in relation to which fixture, at any one time. Add to this potential confusion the possibility that allocations may need to change, due to equipment failure, errors in plugging or the LD changing their mind, and it becomes clear that good record-keeping is the only way a large lighting system can be kept working. Table 2 is an example of a layout for an equipment list to show patch information.

So far we have looked at lists or tables with just a few column headings. These tables present us with the information we need to perform particular tasks. The first might be used to hire equipment for a production, while the second might be used to ensure we have a plan that will help us plug each fixture into the right power and control cable.

The column headings for a full equipment list might look something like Table 3.

Table 3 Equipment list 3

Fixture Type	Hanging Position	Unit No.	Suspension accessory?	Other accessory?	Lamp type	Watts	Weight (kg)	Colour	Frame size (mm)	Gobo inc. size	Multi/Way	Dimmer/Breaker No.	DMX address	No. channels req.	Desk channel No.
ETC Source 4 36-degree profile	LX1	1	Hook Clamp & Rated Safety Bond	Non	HPL/575	575	7.5	L202	170	B Rosco 77721	LX1 A/1	Dim 027	1 / 27	1	101
8' Fresnel	LX1	2	Hook Clamp & Rated Safety Bond	B/D	T11	1000	6.1 B/D	SG53	180		LX1A/2	Dim 114	1/114	1	31
8' Fresnel	LX1	3	Hook Clamp & Rated Safety Bond	non	T11	1000	6.1 B/D	Scroller	180		LX1A/3	Dim 115	1/115	1	41
Scroller for 8' Fresnel	LX1	3a	180mm back plate & Rated Safety Bond	B/D	NA	NA	2.2	Stage Scroll	180		NA	NA	2/301	2	41/ colour
Scroller Power Supply	LX1	4	Hook Clamp & Rated Safety Bond		NA	50	3	NA			LX1M/6	Breaker 12	NA	0	NA
ETC Source 4 Junior Zoom	LX1	5	Hook Clamp & Rated Safety Bond	non	HPL/750	750	7.6	SG 375	190	non	LX1A/4	Dim 028	1/ 28	1	51
PAR 64 Standard	LX1	6	Hook Clamp & Rated Safety Bond	Top Hat	CP62	1000	3.3	L180	255		LX1A/5	Dim 116	1/ 116	1	71
Martin MAC700 Profile	LX1	7	2 clamps & 50kg Safety Bond	Non	700 Watt Short Arc	900	34.5	Standard	NA	Custom 1 see sheet	LX1M/1	Breaker 01	2/ 001	16	1

This table shows information for just six fixtures and one scroller, perhaps less than a quarter of the equipment on just one lighting bar for a medium-sized theatre show. The column headings should not be seen as definitive, but as an example of what might be useful.

Notes on equipment list 3

Suspension accessory?

What extra equipment is needed to get the fixture to stay where the LD wants it? If it is a standard fixture designed for theatre use, and the hanging position is a horizontal 48mm or 50mm diameter bar or pipe, then this will be a clamp of some kind. If the hanging position is a vertical boom, the fixture will need a boom arm or equivalent piece of hardware. If the lantern is to be mounted on the floor, a 'floor stand' or 'floor plate' will normally be required.

Industry standard practice in the UK, North America and elsewhere requires all suspended fixtures and their accessories to have a secondary means of suspension that will prevent further damage or injury should the main suspension equipment fail. This secondary suspension is usually a 'rated safety bond', that is a bonded length of steel wire rope with a securable clip and a working load limit stamped or otherwise attached to it. Safety chains used to be common, but are no longer recommended unless they come with an authorized working load limit. In the countries of the EU it is a legal obligation to use only secondary suspension that is clearly marked to be rated for the full weight of the fixture, and for the clip to be used according to the maker's instructions. Notice that the scroller also has a safety bond specified for it. This is normal practice.

Other accessory?

B/D stands for the barn doors used to shape the beam of a Fresnel or PC fixture. It too should come with a safety bond. A top hat looks very much as the name suggests, except there is no top to it! Top hats are used to reduce flare on lanterns which are either in view of the audience or close to elements of the set or the building. Flare is the unwanted light at the edge of the beam of any fixture with a 'soft' edge – including PARs, Fresnels and even profiles when they are not hard focused. Top hats are also used to shield the audience from direct sight of a light source, which might otherwise cause distraction.

Watts

If the table is a spreadsheet, to be used to work out total electrical loading, the entries in this column need to be consistent. They should be entered either as a number of watts *or* kilowatts (kW). If this is not done, you or your software will not be able to accurately 'sum' the column. The column may be divided into sub-columns – one for each individual supply or phase.

Colour

We have used some common conventions here. L stands for the Lee range of gel, SG for Rosco's Supergel range. Other conventions include # for Supergel, and HT for Lee's High Temperature range.

The scroller on fixture 3 has a number of colours on a roll. Any colour on the roll can be remotely positioned to be in the beam of the lantern to which the scroller is attached. In this case, the exact colours used in each 'frame' of the scroll and their order on the roll are specified on a separate list. The implication of the label 'stage scroll' is that there is more than one set of colours. Perhaps there is one set for lanterns over stage and another for those used front of house.

Frame size

Frame size refers to the size of the colour frame, and therefore the size of colour that needs to be cut. It is normal to cut all the colour for the rig to size as part of the preparation process, to save

valuable time in the performance space. The table specifying each *cut* of colour for a production is called the 'colour call'.

Gobo

Gobos come in a range of sizes, and it is as well to be sure which size is required for each fixture type in the rig. Some lanterns (for example ETC Source 4 profiles) have two gobo slots each of which is a different size, and gobo holders of different sizes too.

Moving lights can have a custom selection of gobos – that is a different set from those the manufacturer shipped with the fixture. The MAC 700 is quite an old fixture now, rapidly being replaced by LED, but still available to companies that don't have larger budgets. A hard-edge moving light, it has CMY colour mixing plus a fixed colour wheel. It also has rotating and fixed gobos that can be specified by the user – in this case these will be shown on a separate sheet. See also the inset section of the plan in Figure 1.

Multi/way

Many lighting systems use multicore to simplify plugging the lanterns in and powering them up. Labelling each multicore and recording which lantern is plugged into which way makes it possible to get the system working quickly, and to find and repair faults. It can be helpful to use multicore labels that mean something. In the example, the five multicore cables feeding the no. 1 lighting bar are labelled LX1A to LX1D connecting dimmers to conventional lanterns, and LX1M connecting the moving lights to circuit breakers. The multicore feeding the second lighting bar would be named with the prefixe LX2,

Figure 5 A short Socapex multicore cable, designed to carry six circuits. The capacity of each circuit (in Amps or Watts) will depend on several factors including the size of individual conductors, the length of the cable, and where and how it is run.

those on the third LX3 and so on. Multicore feeding the stage-right booms might be prefixed SRB1, SRB2, etc., where the number indicates which boom the cable is connected to.

Do remember that both ends of each cable will need to be labelled – with the same name.

Dimmer and DMX address

To make the lighting system work, it is necessary to know which dimmer is controlling which lantern or lanterns in order to patch those lanterns to a desk channel, to enable optimum use to be made of the available dimmers and to enable the crew to quickly switch off the power to any fixture that presents a problem. If a fixture has been damaged, or is in danger of burning a drape, the surest way to address the problem will be to remove the fuse or trip the breaker of the dimmer controlling it.

In the DMX column, the number in front of the / indicates the universe of DMX and the number after the / is the address in that universe. For any fixture that uses more than one channel, the address is the first channel used by that fixture, known as the 'start address'.[9]

[9] As lighting systems become more complex, DMX is being superseded by other control protocols on larger lighting rigs. These include RDM (remote device management) and ethernet-based systems. Some of these systems have bi-directional communication protocols, where the lighting controller (which is usually the lighting desk) can *ask* each connected instrument what it is and where in the network it is, and then allocate it an address.

Socapex multicore protocols

What is Socapex?

It is a trade name for the 19-pole round multicore connector used for production lighting in Europe and North America. It is usually connected to an 18-core cable, three cores per circuit, one for live one for neutral and one for ground, making six complete circuits per multicore.

Although the connector is robust, it should always be treated with care. If a connector or cable is damaged during the build period of a production, it can cause great inconvenience, and may lead to increased risk of electric shock.

Avoid connecting or disconnecting Socapex plugs and sockets live – they are *not* designed for this and repeatedly doing it will damage the pins, which may then cause the connector to no longer work or to work badly, which in turn may lead to equipment failure, or cause fire due to the damaged pins overheating.

Socapex and three-phase electricity

Many Socapex connectors used in the performance lighting industry are not constructed to carry more than 250V. In Europe (including the UK) when two or more phases of electricity are present, potentials of 380V to 415V exist. For this reason and others it is good practice to keep to one phase in each multicore whenever practicable.

Plugging moving lights

Connecting the power supply for the motors and electronics of a moving light to a dimmer can damage the moving light and the dimmer. It is normal practice to have separate multicore for moving light power and for dimmers. This reduces the risk of damaging either. However, many modern dimmers can be set up to provide hard power (this is a commonly used term for circuits set up to power moving lights). Clearly to make safe use of this new feature will require good planning and paperwork, and accurate plugging.

One further word of warning – some PA hire shops also use Socapex connectors. Not every Socapex is a lighting cable – some come from audio amplifiers and feed speakers.

It is usual to separate the power information (hard patch) from the control information (soft patch).[10] In a well-organized production build, all of the patch information can be worked out and made available prior to the fit-up. This should mean that all the electrical and software connections for each fixture are made correctly first time, and the lighting system is ready for the LD to use in the shortest possible time – saving valuable stage time for the more interesting work of actually lighting the production.

Channel number and fixture number

Conventional lanterns with no remotely controlled accessories require a single DMX channel for their control. This can be soft patched to a single desk channel number. A lantern with a scroller will require two separate DMX control channels, one for the intensity of the lantern, and at least one for the position of the scroller – that is the colour. A moving light will require many channels of control. In Table 3, the MAC 700 requires either 23 or 31 DMX channels depending on which

[10] As I said earlier hard patch refers to the physical electrical connections, and soft patch refers to the connections made in the control software – usually in the lighting desk.

mode it is set up in, but does that mean the same number of desk channels? Well, it might do on a simple desk, but it is much easier for most users to think in terms of one fixture, one number at the desk, and any good moving light desk will allow the user to do this.

In Table 3, channel 41, or more precisely unit 3 on LX1 since this fixture may be paired with another in the same channel, is the 8-inch Fresnel with a scroller, so entering 41 at the lighting desk will allow us to control it. Ideally, once 41 has been selected at the lighting desk, there should be one controller for intensity and another for colour available to the user without further fixture selection being necessary. The lighting desk should handle control of the dimmer (dim 115 at DMX address 1/115) and control of the colour (at DMX address 2/301) as if both were part of the same entity – a single fixture with two attributes: intensity and colour.[11]

The same goes for our MAC 700 (Desk Channel 1) but even more so. Now when Channel 1 is entered, the user of the lighting desk should be able to access all the functions of the fixture, intensity, pan and tilt (focus), colour, beam and special functions, without any need to know which function is controlled by which DMX address or addresses: one fixture, one desk channel number (or name[12]). This time the fixture has many attributes, and it will usually be necessary to press other buttons to access all of these. The important thing is that the lighting desk should behave as if all these different attributes are part of a single fixture. So when a desk user types in Fixture 1 they should be presented with a set of controllers for each property of that MAC 700 fixture. The lighting desk should be able to display the state of each property as a part of the information for Fixture 1.

The mapping of DMX control channels to fixture attributes – hopefully in a user friendly way – is accomplished by the fixture personality file in the desk. Each fixture type needs its own personality file. How well that personality file is written, by the desk's software engineers or by the user, will determine how well the fixture responds to the desk.

In lighting systems using DMX, which only allows information to travel in one direction from desk to fixtures, the fixture personality resides in the desk. It is considered the responsibility of the desk manufacture to make it work. With bi-directional communication systems that allow communication back from any fixture to any suitable lighting desk, some fixtures can send personality information to the lighting desk, telling it how they are configured (e.g. mode setting, special gobos) and information about any faults or problems the fixture may have.

Pairing fixtures

Pairing is the term for connecting two or more lighting fixtures to the same dimmer. When reliable electronic dimming was first used in theatres it was expensive. The tendency was to use large capacity dimmers to control two, three or even more fixtures all plugged together, and so all going up and down in intensity at the same time. This presented the LD with a choice – use a few fixtures

[11] Attributes are not the same as control channels. For example, most moving lights use two control channels for the single attribute pan and another two for the attribute tilt. This is done to enable better resolution. On the other hand, some moving lights control more than one attribute with a single control channel. An attribute is what appears in the display of the moving light desk – colour wheel position or gobo rotation speed – while the control channel is one of the eight bit words used to send information to the fixture.

[12] Some moving light desks are moving away from numbers as a way to access fixtures. Instead user definable names enable the programmer to select units in a variety of different ways.

and have control over each one individually, or use many fixtures but lose individual control – large parts of the stage therefore going dark or becoming light at the same time. Dimmers are no longer so expensive, and most production lighting staff will attempt to give each fixture its own dimmer, for electrical as well as aesthetic reasons. There are limits though, and it is frequently necessary to pair fixtures together, for example fixtures in the same colour lighting a cyclorama or other large cloth are frequently paired. Other pairings may be made to cut down on the numbers of multicore cables required to feed a particular lighting bar, truss or structure, especially if that structure moves during the show.

Pairing fixtures together can free up dimmers or cable ways for other uses, including more fixtures, but it can also limit the selectivity possible with the lighting design, and can result in small failures having a larger impact on the lighting. (When the lamp in a fixture fails, it is quite usual for the protective device at the dimmer – the fuse or trip – to fail also. If that dimmer controls more than one fixture, then more than one light goes out onstage.) Decisions on pairing lanterns need to be made with a technical and an aesthetic perspective.

Pairing can also present problems on lighting plans and in paperwork. Hand-drawn plans traditionally represent pairing by linking fixtures together with lines. This form of notation, where it is still used, usually denotes that the fixtures should be paired 'on the bar', using some form of two into one connector, such as a 'Grelco', 'Snapper', 'Ray-Gun' or 'Two-fer'.[13]

In the past, some CAD and lighting paperwork programmes have made it difficult to show pairing, but things are getting better. In any case, there are lots of ways to annotate both plans and paperwork, by hand or by computer, to make things clear; including using coloured highlighter pens to draw attention to paired fixtures, drawing in pairing lines, either by hand or on a layer of the computer drawing, or adding notes to the plan – again either by hand or on a layer of the drawing.

When deciding which fixtures can be paired and how, there are also electrical considerations. These include ensuring that the combined load of the paired fixtures does not exceed the design load of either the dimmer or any of the circuit cables and connectors. As a designer, if you are in any doubt about these issues you need to consult with a professional chief electrician or other experienced production lighting practitioner.

Lighting spreadsheets

Some practitioners hardly use the lighting plan, preferring spreadsheets on paper or in electronic form. Even those who do make full use of the lighting plan will still be producing some information as spreadsheets. Electronic spreadsheets on a computer, whether generated by a drafting program or compiled independently in Excel for example, allow rapid access to data from a number of different entry points. Electronic data can be sorted by many different criteria, and in the right package many different useful documents can be produced. These will include the following.

[13] All names for electrical kit that have one 'plug' and two (or more) 'socket outlets' on the same circuit. Grelco and Snapper are both trade names for UK 15-amp-style devices, ray-gun is a slang term for a particular type of 16-amp splitter, and twofer is US slang for anything that gets you 'two for one'. Some of these devices have their own internal overload protection, or trip. This can be helpful at times, but more often it leads to frustration, especially when resetting the trip requires climbing a ladder.

Table 4 Example colour call

Hanging Position	Gel Colour	Cut Size	Number Required
FoH Balcony Left	L201	8 × 8	4
	#04	180 × 180mm	8
	L200	10 × 10	4
FoH Balcony Right	L202	8 × 8	4
	#03	180 × 180mm	6
	L200	10 × 10	4

Colour call

Colour call is the list showing the required gel colours and the sizes they need to be cut to.

Including the hanging position means the cut colour can easily be distributed to each area in which it is required. If the information is in a computer spreadsheet, the data can be rearranged to suit each use. It might be sorted by colour to find out how many sheets of each type are needed, or by lantern size so that all the 'cuts' of a particular size can be made at one time. A similar document can be produced for gobos.

Shop order

When a production needs to hire some or all of the lighting equipment, a shop order must be assembled. One part of this will be the order for fixtures, but there will be other parts, including the **cable call**, the **accessories list** and the **sales order** (which will include everything from tape and string to colour, gobo holders and gobos). Table 1 in this chapter shows one possible layout for a lantern order, but it could be time consuming to check through this layout as the equipment is loaded onto a truck. A good spreadsheet package can produce a much more usable layout like Table 5.

Table 5 Example shop order

Lantern Type.	Hanging?	No.	Present?
ETC Source 4 36 degree	Hook Clamp	20	
ETC Source 4 36 degree	Floor Mount	12	
ETC Source 4 26 degree	Boom Arm	24	
PAR 64 CP61	Hook Clamp	36	
PAR 64 CP62	Hook Clamp	36	

The 'Present?' column is there to have a tick entered once the successful count has been made. There will be a need to produce a similar check list for accessories, including colour frames.

Patch sheets

Using a computer spreadsheet can make it easy to view the patch in a variety of different ways. Digital data can be searched to find the answer to any number of questions concerning individual control channels, fixtures or dimmers, or whole areas of the lighting system. For example, the data can reveal which dimmer should be connected to a particular fixture, what should be the start address of a fixture, the next available DMX address or the total electrical load of any particular part of the system. Once patch sheets are printed out, they can be carried round, but will be less easy to search, and the data they contain may quickly become out of date. Many production lighting engineers no longer use paper patch sheets, preferring instead to keep data digital and up-to-date, accessed by smartphone or tablet, and if possible linked by WiFi to the lighting desk.

Cables

Even with the most integrated drawing and data packages, some documents will need to be derived from a careful study of the plan and a good knowledge of the venue, for example the cable call.

Cable call

Cable call is the list of multicore and other electrical cables required to realize the lighting rig. Working out the amount of cable required for any single hanging position of the rig is relatively easy – just measure on the lighting plan the length between each fixture and the multicore it will plug to using a scale rule. It's wise to include enough slack to allow for minor adjustments of position, while at the same time keeping down excess cable that might look unsightly or just get in the way.

Working out the required length of multicore and other *trunk* cable to feed each hanging position, which will often include data cables, usually requires a detailed knowledge of the show and the venue. Here are some of the questions that will help to decide how long these cables need to be:

- Where are the dimmers/power distribution/ data distribution for fixtures on this hanging position?
- What route will the multicore and other cables take?
- What might be in the way – set elements, band equipment, quick change rooms?
- Is it okay for the audience to see these cables or should they be completely hidden?

And if the hanging position moves:

- Will the hanging position move in the show or only for maintenance?
- Do we need to include cables for the motors that move the hanging position?
- Where do they need to go to?

Someone will need to answer all these questions and more before they can determine cable lengths. Once all this is known, however, using a document like Table 6 is a quick way of totalling up how much cable is required.

The electrics bible

All the documents we have talked about in this chapter – with others – need to be gathered together and kept current, to help to get the lighting system working, and to keep it working. This collection of essential paperwork is frequently referred to as the electrics bible for the show. It might be a large physical file containing sheets of paper, or it may be a computer file, or it may be both. Whatever the format, the electrics bible needs to be accessible to the LD, chief and crew alike, and needs to be reliably up to date. If it is kept on paper, documents need to be dated, and a system agreed upon to replace out-of-date

Table 6 Example cable call

	20m Multi	15m Multi	Stage Box[1]	Short TRS[2]	Medium TRS	20m DMX	Short DMX
Advance Bar	3	0	3	9	0	1	5
LX1	2	3	5	12	4	1	8
LX2	1	2	3	8	2	0	0
LX3	2	1	3	9	6	0	0
Booms	0	2	2	10	0	0	0
Totals	8	8	16	48	12	2	13
Order[3]	**10**	**10**	**18**	**60**	**20**	**4**	**20**

documents with current ones every time a change is made. If the electrics bible is a collection of computer files, these too will need to be managed, perhaps using version numbers or timed update stamps.[14] Users will need to make suitable provision to back up the files too, since it is all too easy to accidentally change or corrupt vital information on a computer, or spill coffee on a paper file.

Well-designed software packages have the advantage of linking the various formats of document together, and some can even link directly to a lighting control system, feeding, for example, changes in the patch directly into other spreadsheets and the plan.

The electrics bible provides all the information needed to make, maintain and if necessary re-make the lighting for the show. As such it becomes an integral part of the lighting design, and therefore part of the intellectual property of the LD. *It is very important to get this part of the process right.* For many LDs, producing the production paperwork is the boring bit best left to someone else while we get on with 'design'. This approach only works *if* someone competent and responsible is making that electrics show bible. On most medium- to large-scale shows, and for many established professional LDs, this is exactly what does happen. But if you are (or want to be) a working LD it is worth remembering two things:

- Giving a venue poor paperwork for your future lighting rig is much more likely to result in your disappointment when you arrive to make cues than giving them a clear and complete package of lighting paperwork.
- That 'boring' paperwork forms part of your lighting design; indeed if it is prepared in a thorough and professional way, the lighting design should be able to be reproduced without further reference to the LD.[15] As such it is part of what you are paid to produce, and a proportion of your fee may be withheld if you don't produce it. Similarly, if you are not paid in full, you may be entitled to withhold the paperwork – but be careful and take professional advice first.

As a working LD, taking an interest in the paperwork helps to ensure you get the system you asked for and that it will work, while at the same time safeguarding your intellectual property rights and therefore your living.

If you have the time to design your lighting on site as the show is developing, and you have someone willing and able to follow on recording everything so that anything that breaks can be fixed quickly – great. Some fine site-specific work happens just like this. If you don't need to worry that your hard work is being used by someone who is not paying you for it, please don't encourage this practice because the rest of us need those fees! Otherwise protect your intellectual property and take an interest in the paperwork and make sure it does what you and the show need it to do.

[14] I strongly recommend putting 'date last printed' in the document header or as a footer wherever possible.
[15] In reality this is rarely done, not least because productions evolve and the other members of the creative will usually want the LD around to evolve the lighting too.

8

Working in the performance space, part I

In this chapter we will look at the process of getting the lighting rig ready to start lighting. Chapter 9 goes on to look at actually making lighting cues – the heart of lighting design.

In almost all productions the aim is to allow as much time as possible for the creation of the performance onstage, and that of course includes creating lighting cues. Preparation is key to all this, and time spent preparing before the fit-up should release more time for useful creative work in the venue for everybody, including the lighting department.

The fit-up

Here are two very different situations in which a lighting designer might find themselves:

- Working in a fully blackout-able space with hanging positions and suspension points for additional hanging positions, and little else. The expectation might well be that the LD and their team will specify not only all the performance lighting equipment, but also the house lighting and secondary/emergency lighting, suspension kit including pipes, trusses, rigging hardware and motors, all the dimmers and cables, and the power distribution equipment, not only for the performance lighting system but perhaps for dressing rooms, workshops, offices, catering and toilets. They might even be responsible for providing mobile electricity generators for the power.
- Working in a fully equipped repertory theatre with a 'fixed rig' of lighting equipment that cannot be re-focused, re-coloured or re-patched, with perhaps one assistant from the 'house' who can program cues into the lighting console.

Both may well appear daunting for different reasons, and either one should not be taken on lightly. The first because of the range of knowledge and experience required to plan and then realize such a scenario, not the least of which will be extensive project- and person-management skills. How much time and mental space will this leave the LD to make a creative response to the piece and design some performance lighting? The second because in this kind of scenario the work is often more about managing the expectations of

other members of the creative team, and of yourself, than creative lighting design.

However, between these two extremes lie most of the situations encountered by a working LD. For a well-organized production, staged in a working theatre or concert venue, we can hope for good production infrastructure including a range of suitable hanging positions, dimmers and communication systems. Some or all of any equipment supplied by the venue will be able to be adjusted to suit the current production, and some budget will be available to augment the resources of the venue as necessary. Most importantly, skilled and knowledgeable staff will be in place to assist in realizing the dreams of the LD and the other members of the creative team, and part of their job will be to 'fit up' the space. This term covers the installation of set, lighting and sound rigs, and sometimes much more. So in this chapter we will take a look at the role of the LD during this phase of the production process.

Scale determines how much you do

There is probably no such thing as the average fit-up. Each one, in each different space, presents a different set of problems to be solved (or challenges to be addressed, depending on your preferred wording). The fit-up of a 'one-night stand', typical of many live music touring shows and other genre of performance, will be a very different thing to the extended build/rehearsal/preview process of a West End, Broadway or casino show. Likewise the numbers of staff and the skills required to fit up a rig of 40 lanterns in a club or fringe theatre will be quite different to that for 400 in a mid-scale touring venue, or 4000 for an open-air spectacular such as an Olympic opening or closing ceremony. In a club or fringe venue, there is normally an expectation that the LD will 'get their hands dirty' and at least assist if not lead the rigging and plugging of the lighting equipment. On a very large show, even focusing and some cue making may well be delegated by the LD to assistants and associates, because the scale of the project make it impossible for a single LD to do it all.

In most production situations, the LD will normally lead the focus. Just how much involvement the LD has in getting the lighting rig to a state where it can be focused will vary. Generally, the more conventionally hung the lighting rig is, for whatever performance genre, the less need for the LD to lead actions during the fit-up. In most genres of performance lighting, methods of documenting lighting rigs have evolved that are widely understood by the professional crew who build the shows. In such situations, the plans and paperwork are sufficiently unambiguous to allow skilled production lighting workers to mount all the lighting equipment and to make it ready to focus without much further input from the LD.

In situations where the lighting design requires unusual hanging positions, unconventional equipment or standard equipment used in unconventional ways, the LD (or a trusted associate) will need to be on site during the fit-up to ensure things go to plan. An on-site presence will also be useful when other production elements, such as set or sound equipment, need to be rigged where lights appear on the plan. Since the placement of lighting fixtures will often impact on what can or cannot be achieved by the lighting design, the involvement of the LD in negotiating a compromise is usually considered a good idea.

All of this can present the LD with difficult choices. At the time when the fit-up is happening, the final rehearsals will usually be happening too. For shows of all kinds, this is often the time when decisions about where, when and how areas of the stage will be used are made, about the dynamics and the emotion of the piece. The conscientious

LD will wish to be at least aware of these decisions, and preferably be involved in making them. If rehearsals are not happening close to the production venue, the LD will often have to choose where to spend their time – in the venue or at rehearsals.

The choice to be present during the fit-up may be influenced by the amount of time available to 'put right' things that, during the fit-up, have not worked out as planned. Sometimes there is so little time available to fix 'problems' that anything not fully accomplished by the focus session will not happen!

Even in the most ordinary and well-organized of fit-ups, the LD will often visit to ensure that all is going according to plan and to attend to any small changes or miscommunications in person. This is good practice and should be followed whenever possible. However, in most production situations there will be a production electrician, chief, or other person in charge of the lighting fit-up. It is important that, on visits, the LD respects this and communicates directly with that person, rather than bypass them, and give new orders directly to the crew. The chief will often know more about the needs of the wider production and the venue at that point than the LD does, and if the LD wants to have the continuing support of the chief through the rest of the production period, it is a good idea to respect that.

As already noted, in much small-scale work the LD will be expected to lead the lighting fit-up. The temptation here is to skimp on planning because 'we can fix it on site'. I would strongly advise against this tendency. Small-scale venues often have limited equipment and it frequently becomes important to make the best use of every working piece of kit the lighting department can lay their hands on. For example, if only five of the six fixtures you had planned to use as specials are working, you want to be involved in the conversation that starts, 'Which one do we lose?'

LD and chief should have a good understanding of each other's job, and a respect for the challenges each needs to overcome. Many LDs start their professional lives doing their own production work and many top production lighting people started in a similar way. It is important to remember, however, that as the scale of productions you work on gets bigger, so the complexity of both these roles increases. Usually, at some point in their career, a person who is used to being both LD and chief has to decide which role they are best suited for; deciding which lights should be where, and when they should be switched on – or managing how to get those lights there safely and on time, and with all the necessary cables feeding them.

While some LDs have a strong professional bond with one or two production lighting people, and will by choice only work with these people, most successful LDs can quickly establish a good professional relationship with any competent performance lighting crew. They can communicate almost instantly on an appropriate level with each new chief and each new crew. This is a valuable skill, and one that any LD starting out should practise.

Preparation is the key to success

We have already spent several chapters looking at the type and range of paperwork required to prepare and mount a performance lighting rig. The lighting team will have a lighting plan and (at least one) section, extensive fixtures lists, detailing exactly what fixtures will be mounted where, what accessories etc. it will have, what it will be plugged into and how it will be controlled. The shop order will have been placed with the venue or with a lighting hire company, so too the sales order, which will include colour (hopefully cut to

size and separated into packets for each hanging position or area) gobos, lx tape and gaffer tape,[1] string and Black Wrap.

Black Wrap is black aluminium foil – thicker than the stuff you might use in the kitchen, flexible enough to fold and bend into almost any shape. It is one of the best 'get out of jail free' cards to have up your sleeve during a fit-up and focus. It is heat resistant enough to use on all but the hottest lanterns, and it stops light going where you don't want it to go. It can be used to provide an extra barn door, to block light 'leaking' from ventilation holes in lanterns, or from between the front of a lantern and the back of an accessory such as a scroller, and for many other things too.

The need for 'spares'

Productions of all types evolve and change in rehearsals and even during the run of a show. Performers and director respond to the difference between rehearsal rooms and the real set. Changes are made during the final rehearsals in the venue, and frequently after that too, and this leads to changes in the lighting rig. Also, sometimes a fixture does not do what we expect it to. It may not quite work as expected from the data sheet, or as it appeared to work in the visualization program. Maybe what it does is no longer appropriate for the show, or maybe it just does not work. In any case, the fixture or fixtures will need to be changed.

So changes to the piece, faulty or incorrectly specified equipment, and developing design ideas may all call for additional lighting equipment – spares. And every new piece of lighting equipment rigged will require cables and other accessories.

The lighting team will have assessed their need for spares of all kinds, based on factors such as:

- How much of what types of equipment are available 'in house'?
- How far through the rehearsals was the show when the shop order had to be placed? If the answer is 'not very' you should expect changes in the lighting rig to accommodate changes in the show – so the next few questions are . . .
- How close is the venue to the hire company?
- What are the opening hours of the hire company?
- How much time is there in the venue for rehearsals and further development of the show?
- How much time in the venue is there is likely to be to make changes to the lighting rig?

All these factors influence how much 'spare' lighting equipment needs to be on site. Clearly if the rehearsals are still at an early stage when the shop order goes in there is likely to be a lot of guess work in the LD's rig plan. Some of those guesses may turn out to be wrong and changes will have to be made to the rig. However, there is little point in providing spare equipment if there is not going to be any time to rig it! In this case it is likely that the 'spares' would be incorporated into the lighting rig – from the beginning.

There will be other factors for the chief to consider, such as whether the production is to tour, and if so, what is the likely availability on tour of specialist lamps and other items that might fail. Even if the production is to remain in one venue, it is likely that some spare lamps will be required to replace any that fail during the fit-up,

[1] Old lighting joke: Why is black gaffer tape like The Force? Because it is light on one side, dark on the other and holds the universe together.

focus and final rehearsals, and a few extra bits and pieces will be required 'just in case'.

Another factor could well be the size of the production's budget for lighting equipment and the generosity of the lighting hire company. Getting the spares order right is another skill required of the good production electrician or chief – too many spares and budget that could be used elsewhere (and valuable space too) is tied up in stuff that never gets used. Too few spares and valuable time is lost while someone brings spares from the hire company, which could have been on site.

Getting the rig hung

The main activity of the lighting department during a fit-up will almost always be hanging lanterns. It is common practice to winch, fly or otherwise lower the bars or trusses used as hanging positions to a suitable working height, usually between 1 metre and 1.5 metres from the working floor. Wherever this is possible, it speeds up hanging enormously. Where it is not, every piece of equipment and every cable has to be raised to the hanging position, where a crew member secures it, often working at the top of a ladder or similar piece of access equipment. This is a longwinded and tedious process, and if it can be avoided, or limited, it should be.

The crew should always endeavour to get the equipment as close to where it is indicated on the lighting plan as possible. This usually involves measuring the position of each unit from a common datum point, and this is most often the

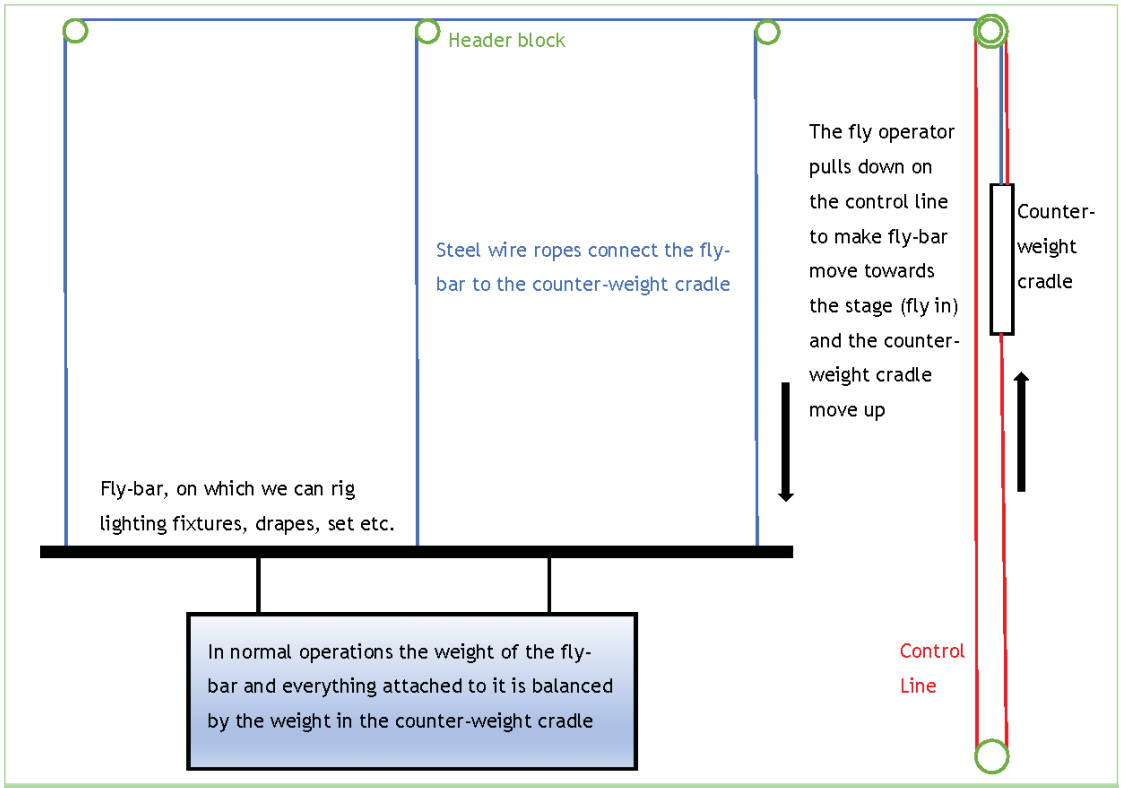
Header block
Steel wire ropes connect the fly-bar to the counter-weight cradle
The fly operator pulls down on the control line to make fly-bar move towards the stage (fly in) and the counter-weight cradle move up
Counter-weight cradle
Fly-bar, on which we can rig lighting fixtures, drapes, set etc.
In normal operations the weight of the fly-bar and everything attached to it is balanced by the weight in the counter-weight cradle
Control Line

Figure 1 A simplified diagram of a theatre-style counterweight fly bar. A mid-sized theatre may have 30 or so such bars in their counterweight system. A larger theatre may have many more.

intersection of the centre line and the setting line. (In a proscenium theatre, the setting line is usually the back of the iron fire curtain.)

Over the stage, each lighting bar (or pipe) truss or other hanging position is located by measuring its distance from the datum point(s) on the plan, and scaling that distance up. Each unit on that hanging position is then placed to match its position on the plan, again scaling up measurements from a common point such as

Working with counterweight flying systems

Although slowly being replaced by motorized systems, many theatre and other venues suspend scenery, lanterns and drapes from bars connected to counterweight flying systems. The basic principle of these systems is that the weight lifted from the stage is balanced by slabs of iron or lead weight in a cradle somewhere else, usually on the side wall of the stage house. These cradles are accessed from gantries, from which operators can load and unload weights from the cradle until the load on the bar over stage is balanced by the weight in the cradle. Once balance has been achieved, a single operator can move quite large loads up and down over stage using a rope line, connected to the cradle via a system of pulleys.

These systems have been in use for over a hundred years, and, provided a few simple procedures are followed, they are safe. It is important that each bar is balanced – if there is more weight in the cradle than on the bar, the bar may move upwards with uncontrolled speed. Likewise, if there is more weight on the bar than in the cradle the bar may move downwards with uncontrolled speed. Either way it is easy to see that the consequences could be severe. Here are some dos and don'ts when hanging lighting equipment on bars controlled by a counterweight system:

- The person in charge of all loading and unloading is *not* the lighting chief, but the head of the flying crew. This person was traditionally called the head flyman in the UK, but times have changed, so let's call them the head of flying.
- The head of flying must be informed of all intentions to hang or un-hang equipment from counterweight fly bars.
- Only when the head of flying says it's okay to do so can anything be taken off or added to a counterweight fly bar.
- *Never* remove anything from a counterweight fly bar without the explicit say-so of the head of flying. Failure to follow this guidance may result in the bar becoming lighter than the cradle, and so moving very quickly into the grid. It is almost certain that this will cause damage to lanterns and to the flying system.
- Don't step over or lean over counterweight fly bars. If the bar should move you will be injured.
- As lighting bars fly out, i.e. move up to 'trim height', make sure someone is paying out the cables. The same applies when lighting bars are lowered, or flown in.
- As a bar is 'brought in' the operator should shout a warning such as 'heads up!' or 'bar coming in!' If you can't see which bar is coming in, move to the wings or to another space outside the area underneath the counterweight bars.
- *Do not* go onto a working gantry of a counterweight flying system without specific permission.

the centre line.[2] Whenever possible the rig should be positioned to the same datum point that the set construction team are using. This gives the best chance of everything being 'as on the plan'.

Plugging up

As discussed in previous chapters, a delegated member of the lighting team will have planned the patch and have a scheme for the plug-up; that is, a power or dimmer outlet and a control channel for every unit. It is important that this information is available to the crew hanging and plugging up the equipment. This may sound self-evident but I have seen too many lighting fit-ups where an inexperienced chief has kept all the plugging and patch information to themselves – and then wondered why the crew are plugging lanterns into the wrong socket outlets.

If there has been sufficient time and space to prepare, all the cables for each bar or truss can be taped together into looms. The idea is that the socket outlet for each unit is suitably labelled and sits neatly above or close to that unit. Using cable looms can produce huge savings in time taken to plug up, and flash out a lighting rig.

Once the individual cables have been connected and attached securely to the bar or truss, the multicore can be attached and secured so as not to put undue strain on the connectors. If the bar or truss is to be flown out, it will be necessary to ensure the cables will not tangle or snag on anything as this happens.

Flashing out

It is a good idea to check everything is working as it should be as soon after the fixtures are rigged as possible. This check is best done by getting as close to the show set-up as possible. This means plugging the cables from the lanterns into the dimmers and power distribution equipment that will be used in the show, and bringing up each control channel on the lighting console to make sure it brings up the correct unit(s) – and only the correct unit(s). This is known as 'flashing out' – each channel is 'flashed' on to ensure that the lantern(s) work and that all the connections have been made correctly.

It is not always possible to flash out from the console. However, since it is generally much easier and safer to fix problems with lanterns at ground level than it is when they are at trim height, it is standard practice, even when show dimmers or console are not available, to flash out as much of the rig as possible while it is at ground level. An increasing number of DMX test devices are now on the market and these can be set to imitate the control output of the lighting console. When the console is not available, a suitable DMX test device can be used to check the function of moving lights and other technology. It is much kinder to the filaments of incandescent lamps to fade them in (over about half a second) or at least flash them out at a reduced intensity (say 75 or 80 per cent) – this will help to reduce the number of lamps blown during the flash-out.

Flash-out is a good time to check that the colour in the frame matches that indicated on the plan or the paperwork, all necessary accessories

[2] It is usually not a good idea to measure from a point on the hanging position itself, since there is no real guarantee that the LD has drawn the bar or truss to exactly the same length as is it is on the stage. This is especially true in theatres, where for all kinds of reasons the hanging bars are often shorter, longer or offset from their idealized position on the venue ground plan.

are in place and secured, lock-off and focus controls are working correctly, and the lanterns are pointed roughly in the direction they will be set in (if that is known) and cables are not too close to equipment that will get hot and burn them. It is a good idea to check that fixed lanterns have sufficient slack cable to be able to set in a different position if necessary, and that cables near moving lights will not get in the way of those lights. Many lighting professionals like to pre-set zoom lanterns to their narrowest beam setting, ready for the focus. All profiles should have their shutters in the furthest out position, and all barn doors should be open. Not only does this help the flash out (because you can see light coming out of the front of the lanterns) but this too is good preparation for the focus.

During the flash-out, the crew may discover cable faults. Getting round these may well involve making changes to the plugging on the bar or in the truss. It is important that any changes required are noted, and recorded in the appropriate paper or computer file, and suitable adjustments made elsewhere in the patch to ensure that everything will still work in the way the plan specifies.

Once the flash-out is complete, and all the instruments have been shown to function properly from the correct control channel, the flown hanging positions – the fly bars and/or trusses – can be set at trim.[3] The next job for the lighting crew will normally be to prepare for the focus, but that cannot usually happen straight away. For example, normally it will be necessary to get all the masking and the major set elements in place and for other departments to have got to a point in their fit-up when they can work outside the space or with very little light or with local working light. If the show is outside, it will normally need to be dark before you can focus.

This wait can be very frustrating for the LD, who is eager to get on, and ready to make some cues. Often there are useful things that can be done while other departments are still working on the stage. The lighting programmer can make colour and beam palettes for any moving lights, and sometimes make approximate position palettes too, and the LD may find small sections of the rig can be focused during a meal break for the other departments. Making the good use of time here will often pay dividends later.

The focus

Getting the lights pointing in the right place, illuminating what they are designed to illuminate and leaving dark everything else, is important. You can't expect to make the lighting states you have been planning if the lanterns are not doing the jobs you planned for them to do. Most performance LDs consider the focus to be key to making their lighting design work. Many production lighting workers rate themselves by how good they are at focusing. Increasingly moving lights of all kinds are replacing the 'fixed' lanterns that used to do all the work. Even so, most performance lighting systems still contain a proportion of lanterns that require crew to get behind them to point and shape the beam. Getting the focus of the fixed rig right – first time and in time – is likely to remain an important skill for both lighting crew and LDs working in live performance for some time yet.

[3] Trim height is the height that bars, trusses and other flown equipment will be at for the show. It is not always possible or advisable to set lighting bars at trim straight away, as they may be in the way or be vulnerable to damage. Whenever this is the case, the lighting crew need to ensure that, before the focus is scheduled to happen, some time is allocated to setting all the suspended lighting positions (and the flown masking if it is to be used) to trim.

Although many LDs run their own focus, this is not always the case. If the show is being reproduced, on tour or as part of a rep season, it might be the touring chief electrician or resident lighting manager who runs the focus. It might be the LD's associate or assistant, or a person appointed to look after the lighting design on a tour – a re-lighter.

Pre-focus checklist

Before the focus can begin, certain things need to have happened or be in place:

- We need to be able to achieve darkness, so that we can see where light is and is not going from each fixture we focus, and be able to spot and eliminate any 'stray' unwanted light.
- The rig should be thoroughly flashed out; each fixture proved to function correctly from the lighting console and have the correct colour and appropriate accessories. (We don't want to have to stop the focus to fix faults if that can be avoided.)
- All suspended lighting positions need to be at trim, and all flown masking, including legs and borders, needs to be in place. (We don't want to focus the lanterns only to discover later that their beams are all over the masking.)
- All ground masking should be in place or, at the very least, accurate markings should indicate where it will be.
- A dim 'safety' lighting state should be established that will allow safe movement throughout the space but will not get in the way of the focus. In theatres, this is often referred to as 'show blues'. It is especially important that any access steps, ramps or unprotected edges and holes have some illumination to prevent accidents (which may result in injury *and* inevitably stop the focus).[4]
- There should be a brighter state, ideally quickly accessible by the lighting desk operator, that can be brought up when access equipment needs to be moved, faults need to be fixed, breaks need to be taken, or in case of an emergency.
- All items of set that are required by the LD need to be available. (Prior to the focus the LD will need to have negotiated with the appropriate department heads exactly what is needed in terms of set and props, and what if anything, can be left offstage, or needs to be moved to provide clear access.)
- There should be appropriate access equipment available, which may be different for different positions.
- There should be a clear, safe space from which to use access equipment.
- Focus crew should be ready and appropriately equipped to access, set and lock off the lanterns.
- Stage crew need to be able to move the set into places if this is required in order to focus some lanterns, and fly crew to move flown set or lighting positions if this is required, or perhaps to adjust the trim of lighting bars or masking if that proves necessary.
- There should be access to a stock of spare lamps in case any blow during the focus.

[4] Following accidents where technical staff have fallen from the edge of the stage, occasionally during a focus, some venues insist on placing a barrier along the front edge. Clearly this can be unhelpful to the LD! I suggest trying to find other ways of reducing the risk of a fall, such as making the edge more obvious, e.g. with white tape or some safety lighting in the void, and removing anything that might increase injury should a fall occur – such as music stands or construction debris.

- Likewise, additional colour and frost should be available, in case these prove necessary.
- There should be a lighting desk operator in communication with the LD.

If any of the above cannot be achieved, it may well be better to delay the focus session until they can be – but often this is not possible and so the LD and the chief have to come up with work-rounds. If some flown lighting positions are not able to be set to trim, or can't be accessed, or don't work, or their 'target' is not ready to be put in place, they will have to be left until later, while the rest of the rig is focused. (If it is about lanterns not working, then any crew not involved in focusing the rest of the rig will be well employed fault finding.) If there are no stage crew available to move the set into place or out of the way, permission may be sought to allow the lighting crew to do this instead – local restrictions may prevent this happening so, as LD, ask nicely, don't assume. The LD and the chief will need to be creative to overcome these problems; but remember you can't focus the whole rig at once anyway, so if it makes others' lives easier to focus a section at a time, why not offer that – it is what you would be doing anyway!

Do insist on having the space dark, however. You need to be able to see the edges of each beam clearly, as well as its centre, and you can't do that in working light. It takes a lot of experience to be able to usefully focus without darkness, and even then most experienced LDs will avoid doing it if possible.

Focus from behind the lantern

Many successful LDs value their experience of being at the other end of the focusing process; that is behind the lantern as opposed to onstage. This experience is really useful. It helps an LD give good directions to their focus crew, and to understand the potential problems faced by them. It also helps them understand the ways in which different lanterns work – which of course helps in choosing the right lantern for each job. Each different type of lantern presents its own challenges and has its own quirks. Anyone who takes focusing seriously should take time to discover the full range of controls on the lanterns they are working with. These will include:

- suspension clamp, pan and tilt lock;
- beam size adjustment, e.g. lens movement on a profile, lamp tray and reflector on a Fresnel;
- beam shape adjustment, e.g. shutters on a profile, barn doors on a Fresnel;
- field adjustment – usually screws or knobs at the back of a profile.

Not every lantern has all these controls, and some have more, including gate rotation and shutter locking on some profiles. Before beginning a focus, the crew should ensure they have the necessary tools to operate all the controls, and especially to lock off each lantern. Few things in performance lighting are more frustrating than, having spent valuable time positioning a lantern exactly where it is required, finding it has changed position because the focus crew did not properly secure all the position lock offs.

The LD and the focus crew need to agree a common set of terms for directions. On a proscenium stage we use the conventions of stage left and stage right – from the performer's point of view. Older proscenium stages were commonly raked; that is there was an incline so that moving away from the audience was going up a slight slope. This was to allow those in the lower section of the theatre a better view. From this we get the terms upstage and downstage.

Focusing a zoom profile

Zoom profiles generally have two adjustable lenses. This allows the beam angle to be varied as well as the edge quality to be adjusted. Although usually not as efficient in terms of light output compared to a fixed focus profile, the added flexibility has made them much more common in many markets. Zoom profiles come into their own in a repertory situation, where each unit may be asked to do a different job each time it is focused. For one show a lantern may be required to cover half of the stage, for the next the same lantern may be set as a special for a single performer on the far side of stage. In a busy rep, such as that found in many large opera houses, zoom lanterns become the natural choice. I am grateful to members of the lighting crew of English National Opera, where up to 200 lanterns were re-focused most afternoons, for the following guide to focusing zoom profiles.

When you arrive at the lantern and before the circuit is brought up:

- Perform a visual check of the lantern, its cables, safety bond(s) and connector to make sure they are all undamaged.[5]
- Ensure the hanging clamp is securely fixed to the hanging position.
- Set the pan and tilt lock offs so that the unit can be pointed, but not so loose that it wobbles – this is usually between a half- and a quarter-turn from fully locked off.
- Referring to the current plan or paperwork, confirm that it has the correct colour in the frame, gobo if required, and that it is plugged to the correct outlet.
- Remove any diffusion material from the colour frame and reserve for later re-insertion.
- Move the lenses to the smallest beam size, i.e. as far apart as they can travel. If you know the approximate direction that the unit is required to point, set it there.

When the circuit is brought up and the LD calls for the light:

- Unless directed otherwise, set the centre of the beam on the head of the LD.
- When the LD is happy with the position, lock off pan and tilt using appropriate tools. Then, let the LD know when you are ready to continue by saying loudly something like ‘locked off’.
- By moving the lenses, set the beam size as directed by the LD – the front lens makes the biggest changes to size – try and keep the beam sharp at this point to help with seeing shutter cuts.
- Set shutters as directed by the LD.
- As directed by the LD, either adjust rear lens to gain required softness of edge, or replace diffusion material in colour frame.
- Check the LD is happy, and move on to next unit.

This is of course a generalized approach, and assumes certain things of the LD and the schedule; that the LD will stand with their head in the centre of where they want the beam, and that that centre once set will not change – that they are happy to set shutters with a hard-edged beam and then to make it soft – and that the schedule allows time for the pre-checks to

[5] As I have already mentioned, it is in the interest of anyone about to touch any piece of electrical equipment to check, as far as possible, that it is undamaged and not about to cause them injury. For anyone working in the UK, a pre-use check is also a legal requirement.

be done. This last can be problematic, and in an ideal world all of the checks performed prior to the unit being switched on (or brought up) would have been done before the focus began. In practice this is not always possible, but if time can be made for the checks it should be.

The very least that needs to happen before any focus, is to check that each unit about to be focused is under control of its assigned channel from the lighting console, or can quickly be turned on some other way.

In practice, another way to allow time for checks is to have two crew focusing lanterns from different positions. Not only does this avoid losing time while a single crew member moves from one position to the next, it also means one person can be checking and preparing while the other one is focusing.

One aspect of focusing from behind the lantern that we have not mentioned yet is the need to get into position. In many theatres, the front of house lanterns are mounted in specially constructed positions with built-in access for focus and maintenance crew. In some larger venues, the over-stage lanterns are hung from lighting bridges, which allow the crew convenient access from above the units. In most touring set-ups, especially those designed for one-night stands, the lanterns over stage are hung from trusses. These can be accessed by specially trained crew, again from above, protected from falls by wearing a harness attached by a shock absorbing lanyard to suitable safety lines. Almost everywhere else (and sometimes even when the lanterns are suspended from trusses) access is by some kind of ladder or mechanical platform.

One thing the crew, chief and the LD need to bear in mind is that dashing up and down ladders can be very draining – and the last thing anyone wants is an exhausted person working above them! Rotating the crew who are doing the climbing through a focus session is generally good practice, and usually pays off by keeping everyone fresh.

A focus crew that have developed a good working relationship with an LD, and have an understanding of the style in which they are working, can speed up the focus considerably by having good anticipation of what is coming next. Very often, banks of lanterns are focused to work together in a wash. Once the first one has been set, the rest are likely to have the same beam size and edge. This helps to ensures that the light from each unit is similar enough to blend together with its neighbour, and that they will all have a similar intensity when brought up to the same level. The focus crew can help out the LD by noting the settings on the first unit and transferring these directly to the rest of the lanterns in that wash. Lanterns used in a wash generally have common ‘cuts’. For example, lanterns from a front-of-house wash may all have an upstage cut in line with a particular feature of the set. The focus crew can help the LD by anticipating this too. Many lighting rigs have symmetrical elements. If the focus crew remember where the stage-right lanterns went, they can help the LD by offering the stage left into symmetrical positions. However, overdoing this kind of thing without consultation can annoy an LD, especially one not used to this kind of ‘help’.

There will be times when the person behind the lantern can see things the LD cannot see. For example, light from front-of-house lanterns spilling over the front edge of the stage. Different LDs will have a different approach to this. Most will welcome a call from the focuser to alert them to this. Some LDs will expect the focuser to deal with such things without being asked, but occasionally an LD will get irritated by this kind of initiative. A good focus crew will support the way the LD is working, and a good LD will make full use of the talent available within the focus crew. As so often

Working at height in countries of the European Union

Legislation in the UK, EU and elsewhere has placed some restrictions on what is and what is no longer possible when crew are working at height. Local rules vary, but the guiding principle is that all equipment used to work at height must only be used as directed by the manufacturer.

This means, for example, if a large label on the access equipment says it must not be moved while someone is at the top of it, then to do so is breaking the law, and is probably also removing insurance cover from the person at the top, the people doing the moving, the organization they are working for and the owners of the venue. In other words, an accident could not only hurt those involved but could also make them very poor and result in bankrupting the organization they are working for.

As a consequence of this legislation and for other reasons, there is increasing use of mechanical access platforms (single personnel lifts, cherry pickers, flying carpets, etc.) in performance venues. These machines can be very useful, but they come with their own problems too. First among these is the need for trained and certificated operators, second is the need to reinforce some stages and sets to take the additional weight of the machine and third is an annoying tendency for the machine to run out of charge halfway through the focus. (Most machines used inside are battery operated.)

Where mechanical access is not practical or not available for other reasons, the time spent going up and down ladders between each lantern or small group of lanterns can add considerably to the duration of the focus session. This can be used as an argument for more budget to hire or buy moving lights to replace some of the now hard-to-reach fixed rig – but money is not available for such luxuries in many sectors.

Instead, the LD needs to think of other ways of making the best use of limited focus time; grouping lanterns together to make them accessible from a single point – making more use of gantry positions and bridges or accessible trusses.

in lighting, making good relationships makes the work easier and usually leads to better results.

Beam edge, diffusion and gobos

The range of diffusion material now available, from heavy frost to almost clear, has changed the way many LDs focus profile lanterns. Rather than softening the edge of the beam by adjusting a lens, it has become common to focus the profiles with a sharply defined edge, and then create the softness that will help beams to merge together by using diffusion in the colour frame. It is much easier to achieve a consistent 'hard' edge and then diffuse it than to produce a consistent soft edge by moving a lens with a consistent accuracy while also working at height, so this approach makes it easier to produce a consistent wash from a number of fixtures. The choice of diffuser is critical, especially when the lanterns are in the auditorium. Too much diffusion and there is a tendency for a significant proportion of the light to 'scatter' away from the main beam and light up the surrounding walls and other features. Generally speaking, we don't want this because it draws the attention of the audience away from the stage. Too little diffusion and we still have the sharp edges – the rapid change in intensity – that the human eye and the camera pick up on, again causing distraction. In an unfamiliar venue, it is as well to have several different qualities of diffusion available.

One place where we cannot usually use diffusion is in front of lanterns with a gobo. Clearly, if the pattern is meant to be crisp – for example if it imitates the words of neon signs, or the outline of a window, we will not want any diffusion or softness. Very often, however, gobos are used to add more or less subtle texture to the stage picture. Rather than use diffusion to control the edge, most LDs will choose to soften the beam by using lens adjustments. As the lenses of a profile lantern with a break-up gobo are focused away from sharp, two different effects are observed. In one direction blue fringing appears and in the other brown fringing appears.

It is usually easier to merge the beams of brown focused lanterns than those of blue focused ones. Also the brown edge is usually considered more pleasing. Whatever the choice, if a set of lanterns with gobos are to be focused to create a soft edged, and more or less even cover, the focus crew and the designer should all be clear about which 'soft focus' they are going to use, blue or brown (see also Chapter 3 Figure 20). Once the edge has been agreed on, it will need to be replicated as closely as possible in the other units of the cover. Many lanterns have graduations or other marking alongside the lens adjustment controls. It is a good idea to make a note of the settings here, though unfortunately, for many makes of lanterns, reproducing these settings on adjacent lanterns is no guarantee that the edge will be the same.

Focusing a gobo cover can be time consuming and difficult, especially if the position of each unit has not been fully thought through. It can be very useful to the LD and speed up the process if the focus crew have a good memory of where they have already set lanterns, and what the beam looked like. Alternatively, it is often necessary to bring up the 'group', i.e. all the fixtures that form part of the gobo cover, each time a new lantern is to be focused. For this reason, it is sometimes useful to point lanterns to be used in a gobo cover away from stage when they are hung, so that unset lanterns will not confuse the focuser or the LD.

Calling a focus from the stage

Leading the focus of a lighting rig, often referred to as 'calling the focus', is a demanding task. To do it you will have to walk across the stage many

Figure 2 Calling the focus from the stage can be intimidating for anyone who is not used to it – and for some of us who are! Try to stay calm, even when things don't seem to be going the way you had planned for, and remember – without a good focus you can't make good lighting.

times, stand in the only pool of light onstage, and call out to crew in distant parts of the venue, either to direct their actions behind a lantern or to ask for channels, or perhaps for quiet. You will do a lot of walking – so wear comfortable shoes.[6] You will do a lot of talking, often in a voice much louder than your everyday voice – have water available,[7] and perhaps boiled sweets or mints to suck on.[8] You can take a tip from the performers and 'warm up' your voice (and the rest of your body) before a focus session.

You will be working in conditions of high contrast, moving about a potentially difficult space often in the dark. (Remember the unprotected drop at the front of most stages, the one into the orchestra pit or the front row of the stalls?) You will be trying to read your notes, and perhaps the lighting plan too – have a reliable torch. You will often get 'stressed out' – develop ways of calming yourself down, such as breathing or stretching exercises, which you can do while the crew sort out a problem or simply move from one position to the next.

You will be exposed – standing on a stage, often literally 'in the spotlight', making strange signals and shouting up to unseen technical personnel. You will be visible to everybody in the venue, most of whom will be invisible to you. This is a little of what a performer feels – if you are not a natural improviser, it is a good idea to have a 'script', a set of words you have thought out and are comfortable with to ask for channels and to direct focus. Most importantly, you will need to command the space. You are doing an important job. It needs to be done quickly and well, and to do that you will need the cooperation of most if not all of the other people working in the space. You will need to be polite but firm, and well very organized.

Ideally, the LD would have plenty of time, a quiet blacked-out space to work in and quick easy access to every lighting position for the skilled focus crew. In this ideal world, every necessary item of set would be in place as it is required, and out of the way when it is not, the masking would have been finally adjusted and the blocking of the performers would also be complete. Ideal worlds don't happen very often and it is a fact of life for most LDs working on live performance that many focus sessions have to be shared with set builders, painters and others. They will be making noise and will need working light. Someone on the lighting team will need good negotiating skills to try to persuade those who need light to work that there may be other jobs they can do during the time allocated to focusing the lighting – sometimes this will not be possible or useful. We will come back to this later.

For the moment, let us assume we do have a reasonably quiet and dark space in which to call the focus. Based on a considered design and good planning, the LD will have a set of focus

[6] Stages, especially during a fit-up, can present numerous hazards to unprotected feet. Everything from sharp unfinished edges to carelessly placed tools and equipment, to gaps in the surface required for the tracks of stage trucks. Many venues insist on all personnel working on the stage during the fit-up wearing safety footwear. This does not usually mean heavy boots (though it can) but it does mean that flip-flops and lightweight tennis shoes will be frowned on, if not banned. It is a good idea to get yourself some comfortable safety shoes, both to satisfy rules and regulations, and for your own protection.

[7] It is not a good idea to have open containers of liquid on a stage. Indeed most venues will specifically prohibit this. The reason being it is too easy for the liquid to spill and cause damage, either to the paintwork or drapes of a set, or to electrical systems. Also spilt liquid makes floors slippery, increasing the chances of slips, trips and falls. Most venues are happy if you use a water bottle carefully, leaving it in an agreed safe place at the side of stage, with the top securely in place.

[8] It is often possible to use radios to communicate during a focus session, or even a radio microphone on the LD. If you do, remember that the crew member may not be able to respond using the radio, especially if they are using both hands to perform the task you have asked for!

notes, which should define where each of the conventional fixtures in the rig will point, what each will light and what each will not light, and which ones will work together in washes, and which alone as specials. Get the focus notes arranged into the order that you will focus the lights. An experienced LD will usually aim to work quickly to set each lantern as the crew arrive at it, working along a bar or truss, regardless of the function of the lantern. This is an ideal and even top LDs sometimes need to go back and forth between positions or along a bar, especially when working on a design for the first time. If you are calling a focus, try to think through what you want from every lantern before you begin. Wherever there is some doubt about whether a fixture can achieve what you want or need, have a back-up plan.

Make time to go back and fix mistakes within the focus session, because otherwise they will become part of the cues you will soon be making, and then it may be too late to fix them. It is often a good idea to leave easily accessible units till last since it is usually possible to set these in between other activity later – say a tea or coffee break during rehearsals.

There are several different and equally valid ways to call a focus. There are also different techniques required when focusing units that will light performers or three-dimensional objects, and units that will light the walls, floors or other basically flat features of a set, and for lanterns whose beams need to blend together and those that will work alone. No one is born being able to call a focus – as with most things practice makes us better. When starting out, it is a good idea to watch others, picking up their good practice to inform your own. Experienced LDs will be able to carry focus notes for 'generic' washes more or less in their heads. They may focus with just the lighting plan as their 'script' or perhaps completely from memory. This ability comes from years of 'having done it' and is an ability that should not be underestimated. If you are new to calling a focus, there is no substitute for planning. Plan as much as possible: visualization programs allow today's LD to try out a focus on a computer before calling it in public. This can be very useful for planning how to focus a wash. It takes time, but it is time spent outside the venue *to save time onstage*, and this is one of our key aims.

If the crew who are focusing are working along similar lines to the way the ENO[9] crew work, the LD works as follows:

- Stand with your head in the centre of where you want the beam, with your back to the lantern.
- Call up the channel. Ask the lighting desk operator to bring up the channel – by radio if possible to save your voice. Sometimes it works well to bring the channel up to 'check', i.e. a level less than full, so the crew member can see where it is and it does not get too hot while they are getting to it. Once your focus crew person is ready, you can say: 'channel x at full please'.
- Direct the crew member to set the beam where you want it. Use bold gestures with your hands well away from your body for maximum visibility. When you are happy, make an agreed signal – such as thumbs up or shout 'lock off there please'.
- When you are told the lantern is locked off, set the beam size, again using bold gestures agreed between you and the focus crew.

[9] English National Opera, based at the Coliseum Theatre in London. The ENO lighting crew on an average day focus anything between 50 and 200 lanterns between them in order to facilitate the repertory system common in most large opera houses.

When you are happy, thumbs up or some agreed command, such as 'that's good!'

- Using bold gestures, indicate where each of the shutters or barn doors should go to shape the beam. For any shape out of the ordinary try to indicate your whole intention first, then each individual 'cut'. Remember that some profiles have a rotating gate and barn doors should rotate too. This may be helpful – but only if the person focusing knows what they are trying to do with all four shutters. Most barn door sets have two long doors and two short ones. Be clear about where you want the long doors (which will usually be to do the most substantial 'cut'). Not everything is possible – be prepared to re-think and to take advice from the person behind the lantern.
- Set the edge of profiles, either by asking for lens movement or diffusion. Remember to be clear about when you are happy with the edge (thumbs up or 'good').
- Check there is no unintentional light, for example spill onto masking or the front edge of stage, or from between barn doors.
- Once you are happy, make sure everyone concerned knows they can move on – either call for the next channel, or for work-light to allow the movement to the next channel. Tick off the set lantern on your focus plot, and move into position for the next channel.

So, before the focus crew set any lanterns, the LD needs to agree signals and directions. As we have said, on a proscenium stage we usually use stage left, stage right, upstage and downstage. In any other situation there is unlikely to be a natural set of directions, unless everyone has worked in that venue before.

One of the more important signals to agree is the 'okay!' indicating the LD is happy with the current action and is ready to move on to the next, or that the focuser is 'locked off' and ready to move on. Once you have this signal sorted out, the LD can give it, and move out of the beam to look at its effect, without the beam following them like a follow-spot. Also LDs will not find themselves waiting unnecessarily, thinking they are waiting for a crew member – while the crew member thinks that they are waiting for the LD. Once an understanding of signals exists between LD and focus crew, the focus can happen quickly, with a good deal less shouting – which usually reduces everybody's stress levels.

It is very tempting at times to look into the lanterns rather than to stand with your back to them. This is not a good idea, and can lead to permanent eye damage – not good for anyone beginning a career in lighting! Get used to judging the position of the lantern by observing your shadow on the stage. Standing with your back to the lantern makes it even harder for the focus crew to hear you – and so signals become even more important.

Finally, remember that focusing can he hard work, for you and your crew, so remember to schedule in regular breaks (and to take them) and try to avoid dispiriting your focus crew by saying things like: 'well if that's the best you can do'.

Making a wash work

The above method will work well for individual lanterns, but most often we need fixtures to work together, and blend into a wash, or a gobo cover. We have already looked at a gobo cover – and compared to a wash, that is easy! A gobo cover generally only has to blend in two dimensions, across the stage floor, or perhaps a cloth or a wall. A wash is normally required to light performers as they move their three-dimensional

bodies through three-dimensional space. It is important to begin with a clear idea of the volume that needs to be covered by the whole wash, and by each individual lantern. In Chapter 6 we looked at the need to think in terms of boxes of useful light within the conical beam of each lantern. In the focus, the LD needs to blend these boxes together. At first, try not to worry too much about what happens to the 'spare' light that illuminates the floor or walls beyond the area that is usefully lit for your performers. With design experience comes the ability to plan for this and make best use of it.

Before anybody has to focus a wash of lanterns under the pressure of a production deadline, they should practise. Getting it right is as much about an instinctive grasp of three-dimensional geometry as anything else. Trying to work this out on the page needs some sophisticated maths beyond the scope of this book. Working it out practically with real lights in a real venue is easier for most of us.

I strongly recommend that any aspiring LD tries the following exercise: making a wash with three zoom profiles from the same angle. You will require a colleague to be behind the lanterns, which need to be at least 5 to 6 metres from the stage. Have a clear picture in your mind of the outline of the 'cubes' that make up the wash onstage. If you like, mark out the squares that make up the bottom face of the cubes. Start with the lantern that will illuminate the central cube – it makes it much easier.

1. Begin as above, standing in the centre of the middle 'cube'.
2. Once the centre of the beam is on your head, and the lantern is locked off, move to the corner or side of the 'cube' that is furthest from the lanterns. Unless you are well above average height, hold a hand above your head and signal for the beam to be spread until it illuminates your hand. Move along the edges of your cube and check you are illuminated everywhere, from your feet to the top of your raised hand. It is not uncommon to have to make small adjustments to the pan and tilt of the lantern at this point – again, with experience this happens less and less. Ask the crew to note the setting of the lenses for future reference.
3. Once you are happy with the overall size, you can call the 'cuts'. I usually start with the 'top' of my 'cube'. Standing on the furthest side of the cube again, I call for the cut to include my fist, but not the tips of my fingers. (I am about 1.7m high and this usually works – you will have to adjust to your own size, and perhaps the sizes of your performers.) Make sure the cut is parallel to the imaginary side of your cube.
4. At the sides, follow the same procedure, ensuring once more that the cut is in line with your imagined cube. Check by walking along the line of your cube with your hand up, to see where the edge of beam lies. You can look at your shadow on the stage floor, or the light on your hand. It can be very difficult for the crew to get side cuts precisely in line – experience will inform the LD's decision about where the compromises need to be made.
5. On the side of the cube nearest the lanterns, the cut lies at stage level.
6. Once the cuts have been set, you can set the edge. Again this takes experience to get right every time. A good crew who know their venue and equipment will often be able to help. Be aware that the size of the beam will change when you soften it with lens movement (another reason to use diffusion material). Even using the subtlest diffusion increases the size of the beam a little though.

In a production situation, try to focus the centre unit first. It is likely to be the most important – as we have already noted, directors and performers both tend to favour centre stage, and it is often the centre of the audience's field of vision. It is worth taking time to get this one right – the others will often be quicker to set if you are confident of having got the first one right – subsequent cuts will very often lie along the similar lines to first ones and once one edge is agreed upon, the rest can be copied.

7 Move onto the next lantern, with a clear mental picture of where you put the cuts for the first one. Many LDs find it easier to work on the next lantern with the first one still on at check, just as a reminder. Again stand in the centre of your next cube (having made any adjustments to where the centre is based on the experience of focusing the first unit).

8 Once the unit's pan and tilt are set, zoom it to the same settings as the first unit. This will help to give you a similar intensity onstage from each of the lanterns in your wash at each percentage setting on the lighting console. Hopefully the size will be big enough. If it is too big, don't worry as cuts will deal with this. (If it is much too small, you may have made a mistake in specifying the lanterns, and you may have to go back to the first unit and make it bigger, or reduce the size of your imaginary cube for this second unit.)

9 Make the cross-stage cuts, matching as closely as possible the line of the previous lantern onstage. Make the side cuts as before. Do not try to match up the side cut adjacent to your first lantern on the stage floor. Remember you are not lighting the floor with these units – you are lighting performers, and usually their faces are more important than their feet. You need to blend the beams together at about face level, so trust your cube and make the cut to that.

10 Set the edge, then have both lanterns on at full. Face away from the lanterns and place your hand about half a metre in front of your face. Move across stage through the two beams looking at how your hand is illuminated. If you can see a sharp line, the edge of one or both lanterns will need to be softened. If there is a bright patch or a dark patch between the two beams, you will need to make adjustments to get rid of this as much as possible. Merging beams in three dimensions is about compromise – this will not be perfect, but making it work gets easier with experience.

Why it might not be working

Successfully merging the beams of two lanterns relies on several things. One of the most important is matching the fall-off in intensity towards the edge of each beam with the amount the beams are overlapping. What we want to achieve is the same intensity where the two beams intersect as that in the middle of a single beam (i.e. the peak intensity). This works if we merge the beams where the intensity is half the peak intensity. In one dimension, i.e. along a line, this is relatively easy.

Even in two dimensions there are problems. The intensity of a lantern's beam generally falls off as a circle. These two beams will only match intensity along the line joining them together.

If we don't cut too far into the beams, and we soften the edges a lot, we can make a good approximation to an even intensity across a larger area than before by merging them at about the half intensity point of each beam.

Go back to the exercise, and take out all the cuts. Make sure the beams are only just big enough to illuminate each cube. Put the cross-stage or 'top' and 'bottom' cuts in and diffuse or soften the edges. Leave the side cuts out. Now walk across the beams – chances are they are much more even across the stage without side cuts. This is because by making the beams only just big enough for the cubes, you are now making use of the natural fall-off in intensity of the lanterns and you are not introducing any potentially sharp edges across stage. In a real life lighting design, if you can adjust your cubes to fit the particular beam angle of the fixed beam profiles available, you will not only stand a good chance of getting your wash to work first time, but you will also potentially get more light onstage (remember fixed beam profiles are usually more efficient that zoom ones).

Focusing moving lights

Since moving lights can be moved into position from the lighting console during a lighting session or during rehearsals, why do we need to focus them before we have to use them during the lighting session or the rehearsals onstage? Here are four reasons:

1. Moving lights are an expensive choice to add to your rig – you should know what you want to do with them, at least for most of the show, before the lighting session and stage rehearsals. You will be able to concentrate on doing this well if they can go quickly to the positions you have planned each time you want to use them.
2. It can be hard to set a moving light in exactly the right place from the sometimes distant lighting console – harder still to set several into the same area, or adjoining areas, especially with the 'distraction' of the rest of the lighting rig on.
3. Moving heads have two ways to point at any given position. If we want them to move 'live', say, across the stage, each position onstage needs to be planned with care so that they do indeed move across the stage, instead of moving their beams out into the auditorium and then back again.
4. Just as it is a challenge to focus an even wash with fixed lanterns, so it is with moving lights, whether they have shutters or not. To do it well needs some time, and usually two people, one onstage and one at the console.

So it is a good idea to record at least some focus positions for your moving lights before any lighting session or stage rehearsal with light.

It is possible to use the same outline procedure to focus movers as we used to focus the fixed rig. If the focus palette is for a look that illuminates the set or the floor, make sure the programmer or operator can see that. If it is for illuminating people, make sure that is what it is doing, either by persuading a person to 'stand' for the programmer as a target, or by directing the programmer yourself as LD, from the stage.

If you are making a moving light wash, set lights individually, set each of the attributes you want to use – which will often only be pan and tilt, but may at times include beam size and edge, and try them together to see how well they merge into an even wash. If beam attributes are used, make sure they are stored, and recalled whenever you want to use the wash.

Once each focus palette is stored, it should be named. Getting the names right is important, and so is building these pallets in a way that means you know how the fixtures will move from one to another, even if you have no plans for the audience to see that happening. It is quite usual

to start with a position 'down stage centre' – which we might label 'DSC'. Then build focus pallets for all the other 8 positions on stage we mentioned in Chapter 6 Figure 8, each time returning all the moving lights to 'DSC' as your starting point. You can also use these 9 positions (USL, USC, USR, MSL, MSC, MSR, DSL, DSC, DSR) as starting points to build more specific focus pallets for your moving light specials and washes. By building the basic 9 focus pallets all from 'DSC', and then using these as the starting point for all your show specific focus pallets, you can be fairly sure that your moving lights take the quickest and most direct route between any two of your stage focus pallets. This opens up the option for moving lights to "follow" performers or set trucks across stage, and also helps to ensure the moving lights are more likely to be close to where you need them any time you want to use them on stage.

One other tip for moving light positioning. Always move the tilt first, and always in the same direction first too. This will help to control 'flipping' which is where the moving light head thinks it should turn upside down to get from one position to another. If you always have the movers the same way up over-stage, the gobos will always be the same way up and the shutters will always be (more or less) where you expect them to be.

Storing a position on a moving light console does more than simply give the programmer the ability to recall that position at the press of a single button. Every cue that is made with units in a recorded position can be updated simply by changing the recorded position.

Supposing we have a solo spot for a song or some other action downstage centre: There are several cues for the solo, building – changing mood – and then fading down at the end. Halfway through rehearsals the director decides that solo should be from the platform centre stage. By changing the pan and tilt of the movers to point at the new location for the solo spot, and updating the recorded focus position, every cue that used that position is automatically updated. So if we had a focus position 'solo spot', we would re-focus the light, re-record the focus position, and the lights would be in the new position for all the solo spot cues.

But what happens if instead of a recorded focus position called 'solo spot' in the original cues we had used 'downstage centre'. If we updated that focus position, every cue in the show that had had units pointing downstage centre would now have those lights pointing to the centre-stage platform. This is just one example of why it is necessary to be thoughtful about naming and using recorded focus positions.

Recording and naming palettes/ presets/focus groups[10]

Ideally, the lighting programmer should have rapid access to every gobo, fixed colour and mixable colour likely to be used in making the lighting for the show. This requires each attribute setting to be recorded as a palette, so that it can be accessed through a single button press. Many modern lighting consoles will do this automatically, but many lighting programmers will want to customize aspects of the process.

[10] Palette, preset, and focus group all mean much the same thing on different consoles. As I have said before, some manufacturers of lighting equipment have patented or copyrighted the use of these words, which makes it difficult for the rest of us to decide which one to use when we don't want to be specific about one particular console, and I wish they had not. I'm going to use palette from here on, particularly since preset has other important meanings for us.

Just as we called the focus positions by names in the last section, it is extremely useful to have names that mean something for all the other attributes of the moving lights. First because it usually makes it easier for the programmer to take the movers to that particular setting if they are looking for a button with a recognizable name on it rather than a more or less random number. Second because when you look at the console's display, it is much easier to see what each unit is doing if the attributes are labelled with a meaningful name rather than containing a percentage or DMX value. Just as calling focus positions for movers by common names makes sense, so too does having the colour and beam selection by name rather than by a number. The LD and the programmer just have to agree on what that name will be. Generally, since it is the LD's show not the programmer's the LD should be allowed to choose the names – hopefully with some consideration for the way the programmer and the lighting console work. For colours, it could be the nearest match in a favoured swatch book (L200), the colour names from one or more swatch books (Double CTB), or a name that means something within the show (Mick's back-light blue). For gobos, the same applies, catalogue number (DHA 407) or name (Dapple) or function in the show (Woodland Act II).

It is useful to think about how names will be displayed when you are choosing them. There is usually a limit to how many characters will be displayed on the screen or on the button, and it will usually be the beginning of the name that is displayed. Suppose we have three different blues:

Blue Act I

Blue Act II

Blue Act III

On a seven-character display they will all be displayed as 'Blue Ac'. Even if the whole name is displayed, it will not be easy to distinguish between fixtures with 'Blue Act III' and 'Blue Act II' on a very full display. Perhaps better names might be

A1 Blue

A2 Blue

A3 Blue

Each palette is now recognizably unique on the screen display and still meaningful. There are lots of other considerations that are specific to particular lighting consoles or programmer's working method. It is in the LD's interest for the programmer to be able to work as quickly and efficiently as possible, so as elsewhere in the process, some consultation between the two on naming palettes is a good idea.

As well as gobos and colour palettes, it is usual to store what might be called beam-quality palettes: 'sharp' for each gobo wheel, a particularly useful 'soft' and different sizes of beam, for example. Some shows may require 'special effects' such as 'strobe'[11] and 'stop strobe' or rotating colour wheels, and these too can be stored under a single button.

Just as with the stored positions, updating the contents of colour and beam palettes changes the contents of all the cues that refer to those palettes. Usually this is just what is required, but it is as well to be aware that it can occasionally lead to surprises.

[11] Strobe light – rapidly flashing light – can work very well in the right circumstances, but can also trigger epileptic seizures in a proportion of the population. In performance it is usual to warn the audience in by a notice on the auditorium doors or in the programme. In rehearsal, it is worth checking that none of the crew or performers are photosensitive before using significant amounts of strobe lighting.

Almost there

Now the rig is in place and focused, and the moving lights (if you have any) have at least some of their required palettes, it is nearly time to start making some lighting cues. Before that, though, there are any number of things still to do or at least to check. These might include:

- smoke and haze (if used) ready, and not about to trigger the fire alarms also check that any air-handling or ventilation systems are set as they will be for a performance (and accept that airflow is likely to substantially change once you have an audience of warm bodies!);
- scrollers all lined up so they all produce the right colour for each instruction;
- gobo rotators, effects projectors and other equipment requiring additional power working as required;
- communications between LD and operator(s) and programmer(s), between LD and stage manager or show-caller, and importantly between LD and the director, choreographer and other designers;
- making sure there is no stray light from offstage workers or exit boxes;
- house lights under control and working as they will when the audience is in the venue (including emergency lighting which may have to stay on when the audience is in);
- follow-spots working and gelled up, with operators in communication with the LD and ready to begin.

Ready now?

9

Working in the performance space, part II

Making states and cues

This chapter concentrates on creating lighting states on the performance stage. Anyone who does not appreciate what goes into the creation of good performance lighting might think that taking eight chapters to get to the heart of what an LD does is rather a lot! I hope that by now the reader will have gathered that creating good performance lighting involves a lot of preparation, knowledge, thought and skill. To begin plotting lighting states and cues there needs to be a fully working, accurately focused rig in place,[1] and we are now aware of many of the decisions that have gone into making that happen.

In this phase of the production the LD is likely to feel under considerable pressure. Time is usually tight and even in the best planned productions there are always limits to the resources available. The LD will need a good technical understanding of what can be achieved with the lighting rig,[2] a good eye for how light is shaping the visual world to be presented to the audience and very good people skills. There is always a danger of becoming isolated as an LD, especially in this phase of the production process. If the LD becomes absorbed in technical detail and forgets to keep talking to the director and the other designers, the rest of the creative team will almost certainly stop talking to the LD until they feel things have gone completely 'wrong' – at which time it becomes very difficult to get the lighting design back to something that everyone can live with. By neglecting proper communication with the rest of the lighting

[1] For all kinds of reasons, many LDs have to, or choose to, sit down to create lighting without the rig in anything even close to a finished state. We will discuss this further in Chapter 10, but for now let us assume that we are in a perhaps idealized position of having had enough time, money and people to have our perfect lighting rig in place, fully functioning and fully focused.

[2] Many LDs have a wide interest in all aspects of technical presentation, from the technology involved in moving scenic elements to the ways in which all the other departments run. The more we know the more we understand and the more can be achieved.

department, the LD almost certainly limits what will be achieved by these people to enhance the lighting design. Sometimes people skills boils down to never be too busy to say, 'Hello, and how are you?' – keep the communication channels open.

Lighting states, lighting cues and the prompt copy

Onstage, a 'lighting state' is the light for a particular purpose, scene or part of a scene. In the lighting desk it is the recorded information to make that state. It can be static; that is all the lanterns maintaining a constant intensity, moving lights stationary and the effect onstage the same from moment to moment. Alternatively a lighting state can be dynamic, including within it changes in intensity (a chase in a fairground festoon or the simulation of flickering fire light) or movement of moving lights or their attributes (searchlights sweeping a night sky, or colours rapidly changing to simulate firelight).

Strictly speaking, a 'lighting cue' is the point in the show when the lighting changes. There will be a time over which the change occurs, and this is called the 'cue time'; more on this later. However, we often refer to lighting states as 'cues' and the stack of lighting states as the 'cue stack'. When a recorded lighting state is played back we say the cue is live onstage. In the time before it reaches the final recorded state – for a static cue this means when the levels are still changing – we say the cue is running in. Just to make matters more potentially confusing, the total lighting state onstage may be the result of several live lighting cues at the same time including some running in and some running out.

The most common method of creating lighting states is for the LD to 'call up' channels or groups of channels, and for a lighting programmer or operator to press buttons or push faders to implement these requests. When the LD is happy with what they see onstage (or wherever) the state is recorded by the programmer or operator, given a number or name, and usually a time or times, and a place in the running order of the piece is defined as the point where this state will be triggered. If the show has a script or a written score, a particular line, or word in a line, or bar of music may be defined as the cue point. If the show is called, that is following the British and North American theatre tradition, there is a show-caller responsible for cueing the show, each cue position will have a number. At every performance, when that point in the show is reached the show-caller will say 'LX NN, go' (where LX is an abbreviation for electrics and NN is the cue number). On the command 'go' the lighting operator will perform the necessary actions to begin the process of making lighting state associated with LX cue NN appear onstage in the recorded cue time(s). In theatre, this is usually done by pressing a single 'Go' button on the lighting console.

The position of each cue is recorded in the 'prompt copy', also sometimes referred to as 'the book'. This marked-up copy of the script or score will be used by the show-caller each night. As well as the position of all the called lighting cues, it will have all the other called cues (e.g. for flys, sound, set), all the warnings for these cues (e.g. 'stand by LX NN'), the 'calls' for the performers (announcements to be made to the dressing rooms to warn each performer to be ready for an entrance) and any other information needed to 'call the show'. In this system, it is the show-caller's responsibility to make sure the show runs smoothly and safely, and when the show-caller says 'Go', the only legitimate reason for the operator not to make the cue happen is if it would be dangerous to do so. As

an LD working with a show-caller, it is clearly just as important to make sure that your cue positions are correctly recorded in the prompt copy as it is to make sure the contents and timing of your cue states are correctly recorded in the lighting console.

Traditionally, for ease of working, lighting states have numbers. When they are recorded electronically they have a memory number. On older theatre lighting consoles there is only one set or 'stack' of these numbers; that is there is only ever one state 101. Many current lighting consoles have more than one 'stack' of states, which can lead to some confusion. However, these consoles allow the user to give each state a name as well as a number, which is some compensation. To significantly reduce the possibility for confusion it is standard practice to use the same number for the 'cue number' recorded in the show-caller's book, the 'state number' in the LD's cue synopsis and the 'memory number' used to recall, replay or modify the recorded lighting state in the lighting console.[3] This goes some way to account for the interchangeability of the words 'state', 'cue' and 'memory'. As we have seen with other potentially confusing double meanings, context will usually tell us what is meant at the time.

Other ways in which the cue might happen for each performance include automatic triggering from a soundtrack, perhaps using midi or time-code,[4] remote devices sending a signal to the lighting console, perhaps triggered by the performer rather than a technical operator, or the operator might learn the show by heart and 'cue' them himself. This is what usually happens in live music concert lighting and perhaps brings the operator closest to the performance. As LD you will need to be aware of the system that will be used to initiate changes in the lighting, and make sure that the correct information is recorded – digitally and otherwise – to enable your vision of the lighting to happen for each performance.

The lighting plan, magic sheets and groups

In previous chapters, we have mentioned the importance of making the lighting plan intelligible for the different users that need it. One of these was the LD making cues in the performance space. For this use we said we needed the channel numbers to be most prominent so that the LD can 'call up' lanterns and groups of lanterns using these numbers. On any lighting system with a 'soft patch' the channel numbers do not have to be the same as the dimmer numbers. As LD, whenever there is an opportunity to decide what the channel numbers should be you should take it. Make the numbers mean something to you. In numbering the channels for the simple rig for Border Crossings' production of *Bullie's House* (in Figures 1 and 2) I took this

[3] Sometimes this is not possible, but the potential confusion arising from almost any other system is rarely worth going through.

[4] Midi is a set of codes developed to allow digital musical instruments and other devices to communicate with each other. Many lighting consoles have midi input and output. Time-code was developed to allow film editors to synchronize images and sound recorded on different machines at the same time. Uses for time-code have developed way beyond this and it can now be found synchronizing the output of all manner of devices in situations from amusement parks to professional theatres and large events. Both midi and time-code provide opportunities for synchronization and automation of lighting and other performance media well beyond the scope of this book. For more information on this complex but fascinating subject, start by looking up 'show control'.

approach. Channels that were likely to be used together were numbered consecutively and consistently. This means I can use the [THRU] function, which appears on almost any desk, to select them all. For example the front-light channels are numbered 1 through 4 with 2 and 4 as centres; the red top/back-light channels are numbered 7 through 10 and again even numbers 8 and 10 in the centre. Even here on this small rig, however, there are inconsistencies. For example, the three overhead specials are numbered in the order that it became apparent they were needed. Originally there were two more, channels 16 and 17, hence the cyc floods start at 18. However, the furthest offstage floods were added later in the process and had to use whatever number was still unused at that point, in this case 30. Even on this small lighting system, numbers did not remain logical for long.

On a larger rig, the lighting plan has to be bigger in order to remain intelligible. If it is printed out, it will be on a larger piece of paper with more lanterns, more channels and more numbers – harder to make sense of in a hurry, taking up too much space – difficult for the LD to use when making cues. By this stage in the process the LD has focused the lighting rig so it is reasonable to assume that they know where all the fixtures are located around the building. What is more important now is the area onstage that they light up, which direction their light comes from and what colour that light is. And this is where the magic sheet really comes into its own.

This kind of magic sheet is a usually a map of the stage with notation to indicate which channel will provide what kind of light for each area. Most working LDs who use this approach develop their own layout; what is important is that it is clear to the user. As LDs we generally make these documents for our own exclusive use – so the only person it has to be right for is ourselves. Figure 1 is a simple magic sheet for *Bullie's House*. The production toured studio theatres without a dedicated lighting crew, and with very little time to build or tech in each venue, so the documentation had to be easy to work from.

Most lighting rigs will need more than one magic sheet to keep things clear enough to be useful. Usually when an LD is balancing levels we are dealing with one or two systems at a time, for example back-light and front-light over a particular section of stage. The systems that are likely to work together are usually most usefully kept on one sheet. Later on there is another example of a magic sheet for a different type of rig.

Lighting design is not, however, about numbers, it is about light. Some people are very happy expressing their ideas in numbers, but most are not. Why talk about the back-light as 'channels five through eight' or 'nine through twelve' when what we mean is 'cool back-light' or 'red back-light'? Many professional lighting consoles now allow us to do just that. By recording a selection of channels as a group, giving that group a name, and allocating a button on the lighting console to that group, the LD and the lighting operator/programmer can select a system of light without any numbers being spoken. Most LDs prefer working with groups with names to working with just numbers. It is common practice to record the groups prior to any work creating cue states – often before the focus too since bringing up the group can be a good check the focus will work.

We will probably want to balance the output of the channels within the group. If a particular balance of intensities is going to be useful more than once there are ways to record the group

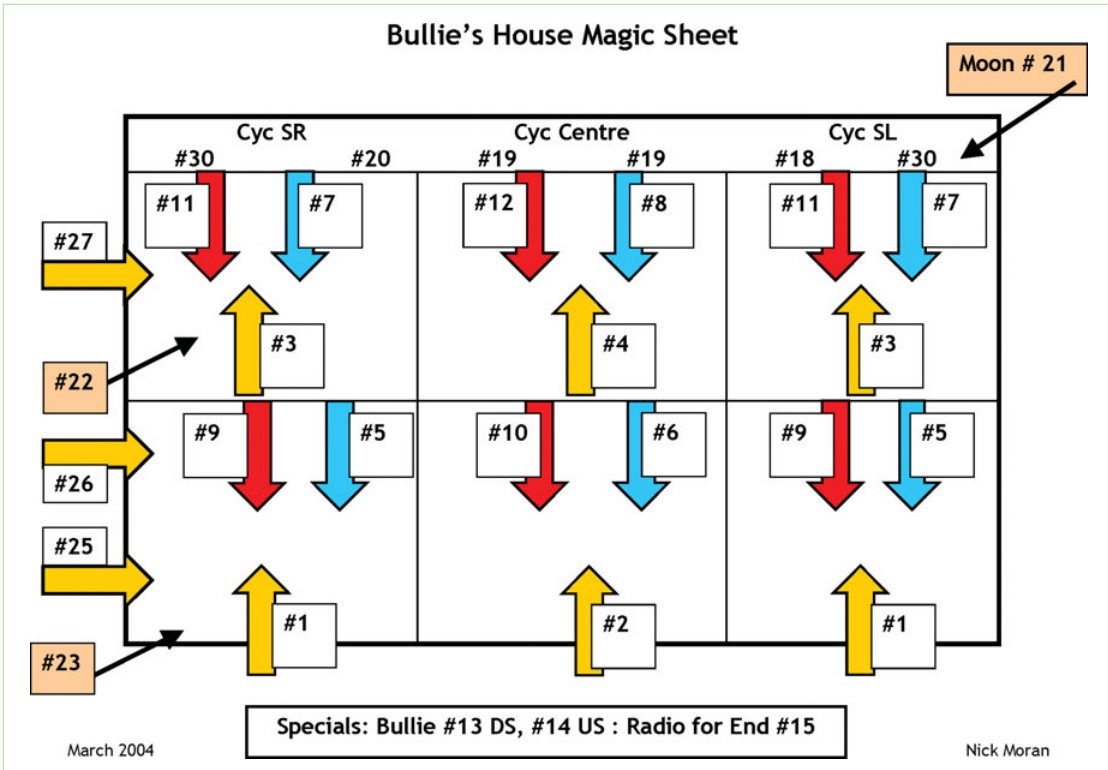

Figure 1 *Bullie's House* magic sheet. The large rectangle represents the stage, split into six areas, with the cyc as the section at the top. The coloured arrows represent the elements of the main washes, with the channel number appropriate to that area in a box beside the arrow. The colour of the arrows is a crude representation of the colour of that wash. The solid arrows are discrete channels that generally work alone. I have included SL and SR on the sheet because I sometimes mix them up and this provides a useful reminder.

with that balance built into the selection on almost every professional lighting console.[5] For now at least we may have to return to channel numbers to do this, but if the individual channels within the group have been numbered in a logical way, this will be easier.

Figure 2 is a group sheet for *Bullie's House*, with the contents of each group in the second column. The order of the numbers written in the second column mirrors their effect across the stage looking from the production desk, which should help us if we need to balance the levels within a group.

The purpose of these documents, LD lighting plan, magic sheets and group list, is to help the LD do the job of making lighting cues. It is worth spending some time preparing the type that suit you best, and this might change from rig to rig. The important thing is to make sure they are tools that help to get the show lit, and not burdens

[5] Usually the word 'proportional' come into the description of this function, e.g. proportional patch or proportional group.

Bullie's House Group List

Gp No.	Group Name	Contents
1	Front - Light	3 ; 4 ; 3 1 ; 2 ; 1
2	202 Back-Light	7 ; 8 ; 7 5 ; 6 ; 5
3	Red Back / Top	11 ; 12 ; 11 9 ; 10 ; 9
4	DS High Cross	26 25
5	US High Cross / ¾ Back Light	27
6	Cyc	30;20;19;18;30
7	Moonlight Key	21
8	Moonlight Fill	22 23
9	Death Specials	14 13
10	Radio Special	15
	House Lights	? ?

Figure 2 *Bullie's House* group list. Using groups is a good way of allocating meaningful names to groups of fixtures that do the same thing – and will often be used together. Even on a small rig such as this one, it can be especially useful if you really don't like using a lot of numbers.

that drain creative energy or limit what can be achieved with the rig.

The production desk

The LD will need a place to work from, and this is usually the production desk, often in a central position in the auditorium. This position needs to be a centre of operations for the LD. It needs to have a good view of the whole performance space and it needs to have good communication links to all the people that will be working to make the lighting the best it can be. The production desk is the LD's work space during much of the build and technical period, and often up to the first public show – and it needs to be treated as such by everyone.

The production desk is where the LD will keep the show paperwork.[6] As well as the lighting plan, magic sheets and group list, there will be a cue synopsis outlining the provisional composition of each proposed lighting state and the position of each proposed lighting cue – all ready to be referred to and updated as the lighting states are made and recorded.

Most LDs will want remote monitors from the console displaying the contents of cues and the details of the cue sheet. While the LD will be concentrating on the stage most of the time, and should know the rig well enough to be roughly aware of the effect of each channel on the stage, it can be very useful to be able to see exactly which channels are at what level. Many questions can be answered by a quick look at a well laid-out console screen, for example; the dull glow at the top of a flat is channels we forgot to take out from the last scene, the lanterns with scrollers look too yellow because they have the wrong colour rather than because they are dimmed down or the cue we are just about to modify is not the one we should be working on! However, the LD needs to focus on the stage more than numbers on screens, and we will need to make sure that monitors do not interfere with our view of the stage.

The production desk will be home for some hours – perhaps some days or weeks – so it is worth making sure it is reasonably comfortable.[7]

[6] Of course this 'paperwork' could be digital, stored and accessed by computer. If it is, be sure you have back-up copies, on a memory stick you take everywhere with you or perhaps remotely stored on your own private website, accessed over the internet and protected by password. You cannot work without this information so you need to protect it.

[7] That includes knowing the route to the nearest 'comfort zones' – the best way to a place with some fresh air, perhaps a coffee shop or tea room, and of course the nearest rest rooms or lavatories.

However, I would strongly advise all LDs to make sure they regularly get out from behind the production desk, to look at the performance area from other perspectives and talk to the director and others face to face away from the technical paraphernalia that can easily inhibit creative discussions.

Do not underestimate the potential for stress at the production desk, or the often destructive consequences of not dealing well with that stress. At the end of the last chapter is a short checklist. It is worth adding some things to that list that the LD can think about providing for themselves. We usually feel better when we have elements of our immediate environment under our own control. Each person will have their own tools and favourite things that can provide comfort or relieve stress. These will probably include supplies of favourite mess-free snack food, sweets and drinking water, preferably in a reusable bottle. (All of this generates rubbish – so make sure you have something for that too.)

For many the comfort of your own laptop computer (with or without peripherals such as printers, speakers, web cam or media drive) is essential, whether or not the machine is used for making lighting or documenting the show. You might have a personal work-light, or a mascot, or a stress ball, and a charger for your mobile phone or tablet. You will need a notepad and something to write with – don't rely totally on the computer unless it really does go everywhere with you. Even then, you will often want to give written information – lists of missing items, a request for colour or gobos, or just the lunch order – to an assistant or other helper.

Try to avoid liquids and messy food at the production desk, even though it is often easier to stay there for your 'break'. In the dark it is all too easy to knock over a cup or container and spoil a plan, make important notes unreadable or wreck a computer. Best to stick to dry snacks and to take regular breaks for coffee, tea, or whatever, away from the production desk.

At the top of the checklist was communication. It is worth reminding ourselves again that an LD rarely works alone. They will need to be in communication with:

- members of the technical team, for example the programmer or lighting console operator, the chief or production LX, and the follow-spot team if you have one;
- the team running things onstage, for example the DSM or show-caller and the stage manager;
- the rest of creative team.

Each of these three teams of people requires a different kind of communication. With the technical team, the LD will often need to communicate specialist information using technical language particular to performance lighting; for example talking about moving light attributes, colours referenced to swatch book numbers or console procedures, and, almost inevitably, lots of numbers. With the stage management team the communication will focus on the correct timing and placement of lighting cues in the script, and other matters concerning the mechanics of how things will run onstage. There will be lots of numbers here too; page numbers, cue numbers, even bar numbers (both musical bars and flying bars), numbers of seconds and minutes, numbers of people onstage and lots more.

Communication with the creative team should be much less about numbers, much more about ideas. At times the LD becomes the conduit between director and stage manager, translating creative ideas into the technical language required for their realization, and a good LD will need to handle this alongside all the other stuff. It

can be hard jumping between these different modes of communication, and remaining polite, but that is almost always part of the job. Well in advance of the time allocated in the schedule for stage rehearsals with lighting, the LD needs to make sure they will be able to communicate effectively with these three groups of people.

There is more to communication than having the physical channel set up (that is the headsets and 'talk-back' systems, or just being close enough to talk face to face). It is a good idea to know not only everyone's name, but the form of their name they would prefer you to use; for example, sir, Mr Smith, Philip, Phil or 'darling'. Often the LD will hear a voice at the other end of the talk-back system, and may need to talk to that person for hours without ever seeing them. This can take some getting used to. It is a good idea to adopt an etiquette on talk-back that acknowledges the missing elements of communication between people – you can't see each other. This may mean people need to limit their use of irony and sarcasm as these can easily be misread over talk-back. Also assume that you are being listened to by the person you are talking about, or a close friend of theirs – because you just never know . . .[8]

Catching up with creative collaborators

If you have been busy with all the business of overseeing the preparation of your rig while the director and others have been in a rehearsal room with the performers, you may need to re-establish good relations with the creative team. As LD you will need to find out if anything significant has changed since the last time you were in the rehearsal room. You will need to make your creative collaborators aware of anything you have discovered that might impact on your work together in the coming hours, days or weeks. (However there is little point in raising levels of stress and tension by telling them tales of woe at this point – it won't make your life any easier.) Alongside the 'work' stuff, you will want to know what sort of mood everyone is in since this should effect how you communicate with them. You are likely to be working long hours with these people – it will usually be easier if everyone can be as relaxed and open as possible with each other.

The director is not the only person who can fill you in with information on changes and moods. Indeed unless the director has a strong technical focus they may not even be the best person to do this. The stage manager or the production manager should know if there have been changes that impact on the technical realization of the show – anything from changes in the location of a scene onstage to a major reordering of scenes has been known to happen in the final days in the rehearsal room. The DSM or show-caller will be the best person to let you know about any more subtle changes such as small changes in the script or blocking changes.

All the practising LDs I talked to say that if at all possible, find time to sit down with the director to agree a way of working before making your first lighting states. It is important at the beginning of this process to establish trust – the LD needs to ensure the director maintains a belief that they can successfully light their show. This is especially important if the LD and director have not worked together before. For example, the LD

[8] The same applies on stage – most theatre spaces have a microphone over the stage to 'relay' the performance into the dressing rooms and backstage areas. The idea is that during a show, the performers and crew can hear what is happening without everyone having to wait at the side of stage all the time. It is always best to assume this 'stage relay' system is on and that people you can't see are listening to you whenever you are on a stage.

may need to be clear if they are presenting states as 'a work in progress' or as more or less finished. Many LDs like to sketch in ideas to begin with, holding back on adding too much detail too early and waiting for a 'language'[9] to develop. This way of working allows the team to 'write' a lot of lighting states relatively quickly and define an approach that has a consistency – that language we were just talking about. Fine adjustment such as balancing levels to more subtly focus audience attention or remove distracting shadows can come later, perhaps when the blocking is more settled. But if the LD is not clear about the way in which they are working, the director may be horrified by, for example, sketchy states, and lose confidence in the LD's ability.

Placeholder cues

Trying to create the right lighting state for a difficult scene can sometimes seem like hitting your head against a brick wall. Everything you try seems not to work. When this happens, many LDs use the idea of a placeholder cue – a cue which we know we will need to come back to, perhaps when we are more certain about the languages that work with the whole show. Meanwhile we move on, to keep the creative process flowing.

This has proved to be an especially valuable way of working for many less experienced designers. It gets the creative process moving again without undermining the LD's position in the creative team, and can allow difficult lighting problems to be solved later when there is less pressure – say during a break when the whole cast and crew are no longer 'just waiting for you', and the director appears to be breathing down your neck!

Think of the placeholder as a kind of 'get out of jail free card' from the board game Monopoly. Don't try using it too often or it will stop working. A conversation with the director before the session begins will often give clues as to their mood and degree of nervousness. (Don't think that the LD is the only one with nerves at the beginning of rehearsals onstage. Many directors find technical rehearsals very difficult, often because it is a part of the process they feel they cannot properly control.)

As well as letting the director know how you intend to work – or rather agreeing a way of working to create the light for the performance with the director – as LD you need to know how the director will be working with the performers on the stage. How close to a 'finished product' is what will be presented at these first stage rehearsals? How much work will the director still be doing with the performers onstage and how much time will he or she have to attend to other matters, including the lighting?

One of the key things the LD needs to establish is how much the blocking[10] of the performers

[9] We are borrowing here from modern linguistics and semiotics. The idea is that, as with other signifiers on the stage, lighting can work best if its signifiers can work as a 'natural language'. By analogy with the generally consistent meaning of words in language, if light of a particular quality signifies a particular place or time of day once, when that place or time of day needs to be signified again, the same quality of light is used. Each different quality of light used relates to the others – in intensity, direction, colour, etc., in an analogy to the way the words in a sentence relate to each other and help us understand the whole sentence. If we don't push this analogy too far it can be very useful.

[10] Blocking refers to the moves and positions of the performers. Sometimes a director will be very definite about where each performer is at every moment of the piece – in a dance piece for example this is normal. Other genres are more relaxed about where the performers are onstage at any particular moment. There is little point in making tightly defined areas of light for a particular scene if the performers have not yet become comfortable with the space of the stage, and therefore do not have tightly defined places to be for that moment, unless by doing so you can help them to feel more comfortable, and make the show better.

might still change. For example, how close will the positions to be taken by performers onstage in the coming rehearsals be to final positions taken when the piece has an audience? If there is to be a period when the director is trying blocking ideas out, can they give you some idea about when positions will become final? There will be aspects of the performance that are affected by the change in space from the rehearsal room to the stage, and it will usually be the director's primary concern to work on these things first. As LD you may well need to explain why confirmed blocking is important for the realization of the lighting design (if it is), and if it is important for particular sections of the piece only.

If possible the LD should find out if there are particular parts of the piece that the director is nervous about; maybe a section is not working in the rehearsal room, or there is uncertainty about how to play a particular scene. Ask if the director needs help from the LD or perhaps wants this section left in something like work-light until a way forward becomes clear. Perhaps there is a particular section that everyone has said 'will be solved by lighting' and now the director wants to be sure that it can be. Decide if you both want to solve this problem first or leave some time later – once the 'language' for the lighting is clearer to you both.

Negotiating lighting over stage rehearsals

Most important, decide if it will be okay for the LD to try things out during rehearsals. Clearly the LD and the lighting team will need to assure the rest of the company that they will not be plunging the stage into darkness at inappropriate moments during rehearsals! That said, try and establish that it is okay to add or subtract light, change its colour or shape, and generally work on a lighting state while the scene is being rehearsed. Sometimes directors find this too distracting from their main focus, which may still be getting a good performance from the actors. However, if the LD can make use of the populated stage to work on lighting states it is generally better for all concerned. Sometimes it is possible to work on lighting states for a scene other than the one being rehearsed. It is often enough to just make the director (and set designer) aware that this is what is happening (and to ensure there is enough light onstage for everyone to see what they need to see). For example, during the rehearsal of a long daytime scene with few cues, the base states for a sunset in the following scene might be tried out and recorded. So long as everyone knows what is going on this is not usually a problem, and it reduces the time needed to plot these states when the rehearsal moves on to the next scene.

Making cues

Let's take a moment to check we have everything in place to begin lighting the show:

- the lighting rig is fully focused and fully working;
- the lighting console likewise is fully working and the operator/programmer is ready to work;
- all other necessary operators are standing by to do their jobs;
- communication systems are in place, tested and working to all the people that need them;
- the house lights are under control, and the emergency and other auxiliary lighting is as it will be during a performance;
- the LD is comfortable at the production desk, snacks and liquid refreshment on hand;

- the production desk has at least one functioning work-light that the LD can turn on and off;
- the paperwork (plans, magic sheets, group lists, cue synopsis) is accurate and up to date and available to the LD at the production desk;
- the LD's script/score/running order is accurate and up to date and available at the production desk;
- if we are plotting a called show, the show-caller is standing by with 'the book' ready to enter cue points and call cues;
- the lighting operator/programmer has a suitable 'emergency' state that will put light onstage no matter what else is happening – just in case;
- the director is in a good mood and ready to collaborate in the creation of the lighting for the show;
- all parties concerned have agreed where in the piece they are going to start work – very often this is not the beginning of the show, and if that is the case everyone needs to be aware and ready.

Lighting over rehearsals vs lighting sessions

After standing in the beam of the lanterns for the focus, we usually want to see their effect from the auditorium, individually and in combination. Trying a few things out before the first lit rehearsal, however, is not what most people mean by a lighting session, but that is a good way to use any spare time you get prior to the first rehearsals onstage with the performers.

In the past the 'lighting session' was an important part of almost every production period in theatre, opera and elsewhere. Schedules included a block of time given over to the LD, and (usually) the director and set designer, to work on lighting states and transitions without the cast. The expectation was often that every lighting cue would be built and recorded during the lighting session, and then just played back over the dress rehearsal. Often this block of time would be late at night.

Most contemporary LDs want the focus of their lighting to be on the performers. With no performers on the stage this is difficult. Sometimes the junior members of the stage-management department are available to 'stand in' for key performers and 'walk' the stage, but this is rarely a satisfactory substitute. All too often so much adjusting of the lighting to the performers has to be done once they start rehearsing under the lights that all concerned begin to feel that the hours spent in the lighting session could have been better spent elsewhere – in bed asleep perhaps.

This is definitely not to say that a more satisfactory solution is for the LD to begin the first lit rehearsals with nothing 'in the desk' – no lighting states ready to try out. Using visualization software or in other ways it is possible to 'blind plot' cues – maybe a basis, maybe just the rough time, maybe pretty much the whole thing. But even if you have plotted every cue in a lighting session without the performers, most LDs want to try a few things out and examine how the pictures in our heads (or on a computer monitor) compare to combinations of light from real instruments in the real performance space with the real performers moving in the space.

Experience and local practice will help an LD decide how much useful time should be spent plotting lighting states and transitions without the performers in place. Complex transitions or scene changes where the primary focus is not on the performers clearly will benefit from some

preparation. No one will thank the LD for working on a multi-part sunset on the cyclorama while performers and others sit around waiting. Indeed in the professional world where each person's time is money, the production manager or producer will quickly point out how much each hour with performers and full crew onstage is costing. At the same time, lighting that is sensitive to the moves and moods of the performers is all but impossible to create without those performers present. How can we judge the quantity and quality of light that best supports a performer at key moments in the piece without being able to see that light on the performer?

So what use should the LD make of lighting sessions? If we can no longer expect the lighting session to produce a finished product, it can still be useful in a number of ways. This may be the last chance to check the focus of all the units in a group to make sure they work together. Lighting sessions are a time when the LD can try out the elements of the rig and to see for the first time if they will work as planned. If the LD is working with a cue synopsis that includes the groups and specials planned for each state, these can be looked at working onstage together and evaluated. Even a relatively inexperienced LD should be able to tell most of the time if the general idea is going to work or not, without the performers needing to be there. There will always be surprises, usually some good and some not so good: a particular wash that works surprisingly well to do two different things at different intensities; a cross-light special that beautifully sculpts a scenic element it was never meant for; or a particular combination of scenic colour and light colour that is just not going to work! A lighting session can be very useful for discovering these things too.

Another use for the lighting session is to reinforce the relationships between the LD and the rest of the creative team. Often the LD will be seen operating primarily in a technical role during the process of rigging and focusing. The lighting session can be a time to demonstrate once more their creative artistic side. As we have already commented, it is necessary for the director to trust the ability of the LD to work in a style that complements their own. If the two have not worked together before it is especially important to establish that trust quickly, and a good way to do this is to sit together and discuss light on the stage without too many distractions. In the early chapters we commented on how hard it can be to talk about light in performance, especially with non-specialists. It so much easier to show your collaborators the quality of light you wish to use to evoke a particular time, place or emotion than to describe it.

However, in British theatre and elsewhere the dedicated lighting session is disappearing. Prohibitions on overnight working and a general wish to control overtime costs of staff are both factors in its decline and this is not entirely a bad thing. After all, how fresh are the creative team on the morning of the first stage rehearsal, if the night before they were looking at lighting states till 5.00 am? It is usually worth stealing some stage time to look at lighting states – preferably with the scenery in position – before lighting the performers for the first time and if this can be done with the director and set designer, all the better. If there is no scheduled time for a lighting session, many LDs will attempt to build a session into the end of the focus time, or by agreement work over a scene-change rehearsal – being careful to ensure that this does not make things more dangerous in any way.[11]

[11] Remember in the preparations for making lighting states I mentioned having a fader on the console that brings up light onstage in an emergency.

Making a start

If you have done all your research and preparation (and you are in luck) your focus will have gone well and confirmed for you that your key ideas will work. Maybe you got some time to try some key looks, in a lighting session or in another way. Anyway, you are in the happy position of having 'something in the desk' for most of the show. This is the ideal position to be in – and certainly at first, this is what you should aim for on every production. However, sometimes it just does not work out, and you come to the start of the technical rehearsal not really sure of anything, let alone what to put up for the first cue!

When this happens, because it almost certainly will, the first thing to say is that we have all been there. It is likely that everyone else in the creative team has been there too. Writers and visual artists frequently talk about the difficulty of staring at a blank page. How do you make a start on an article, a book, a sketch or a painting? Or a lighting design? By the time you get into the performance space for the technical rehearsals, you have probably already faced the equivalent of several blank pages! The blank page of the text analysis – what is this piece about and how do I respond to it with light? The blank page of the lighting plan – where am I going to put my rig? And perhaps the blank page or the colour call, the gobo list and the group list too. And now the blank page of the lighting console's cue one.

One piece of invaluable advice from multi-award-winning lighting designer Paule Constable: just bring up a channel – any channel – look at what it does, and make a response to that. It may be the right choice first time, but it probably won't be and that's not the point. The point is to look closely at what that light does onstage – to the set, to the performers and their costumes, and to the rest of the space – and let that response guide your next move.

Even if what you bring up is your fully planned and tested cue one, once the performers are onstage, you will need to look just as hard at everything as you would bringing up a more or less arbitrary channel. Look closely at how well your light is doing the jobs it needs to do for the production, and respond to what you see working and not working.

- Can you see clearly the things that need to be seen clearly?
- If not – what can you do to correct that?

This might be re-balancing intensity – a little more key-light perhaps, or just as likely a little less light elsewhere (say on a cyc) to bring down the general level and open the irises of the audience.

- Can you see things that should be hidden?
- If so, what needs to change to hide those things?

This might be as simple as turning off one fixture of a group, or it might mean something needs to be moved onstage, or one of your lanterns needs to be re-focused.

- Are the colours working? Do check that the paint finishes and costumes are completed, but if they are and something the light is doing is not working well with them, which should change?
- Are there distracting shadows somewhere? Where are they coming from? Can you light from a different direction, throwing the shadow somewhere less distracting or do you need to wash out the shadow to reduce the distraction?
- Or maybe a distracting glare, a reflection from something shiny onstage or a moving light pointing into the audience?

Ideally you will be able to make modifications as the rehearsals are happening, lighting over the rehearsal. This is often the most effective way to work, quickly fixing problems as you go along. It requires quick thought and consideration for others – you don't want to plunge the stage into darkness unexpectedly, for example.

Things change during tech!

If there is a relatively major change – say to blocking or the way in which a scene change happens – then the rehearsal will stop while the new blocking is worked out in detail. This will usually give the LD and their team time to modify the states before the rehearsal continues. Do make sure that everyone who needs to know is aware of what you are doing (particularly the director and stage manager), and try to be ready to carry on as quickly as possible once work on the change has been completed.

As the creative team begin to define and build the visual languages, including the language of the performance lighting, you may all find that you're moving away from the original ideas. Whole scenes or numbers may end up being staged very differently to the way they were originally envisaged, as together you all discover what works well and what does not work. This can be an exciting time – often fuelled by adrenalin and coffee. Don't be surprised, though, if others don't immediately recognize the technical implication for lighting of – for example – major blocking changes that requires you to re-rig lanterns. It's part of the job of the LD to communicate these implications to the creative team – and perhaps the production manager too – helped by the production electrician or chief electrician. You may both need to say something like, 'If we do this, then lighting will need x hours to re-rig and y hours to re-focus before we do this scene again'.

Fixing as you're going along

If the agreement between director and LD is that the rehearsal will only stop for lighting as a last resort – and this is often the case – finding the things that are not working and fixing them 'on the run' requires a lighting team that is working quickly and efficiently.

Perhaps a costume catches too much light and takes focus from where we want it; a channel within a group will need to be reduced in intensity or otherwise dealt with to restore the state to something that works with the other elements of performance. Perhaps the balance of key and fill is not quite right in one area of the lit stage. Again the offending channels will need to be located and levels adjusted accordingly, but at the same time as the rehearsal continues and cues are being called and executed. The flaws in a particular state may only reveal themselves for a short time as rehearsals continue – long enough to distract audience attention, but not long enough to diagnose the problem and fix it – unless:

- the LD is very aware of what each lantern in the state is doing;
- the LD can decide quickly on a remedy;
- the operator of the lighting system can make the adjustment, and record the change, hopefully while whatever revealed the flaw is still present and before the next lighting state is required onstage.

A speedy effective response to any flaws is important. When things can't be fixed while the rehearsal is continuing, the LD has a clear choice: stop everything and fix the problem or take a note and hope there is time to come back and fix it later. This is rarely an easy decision, even with lots of experience. But very often, if there is time, it is better to stop and fix a problem rather than let it continue and distract everyone

from other issues. This is particularly so when things are happening in the dark and they should not be! When this happens, it is almost always better to stop and fix – by turning on another fixture, re-focusing a moving light or agreeing a re-blocking of that moment.

At other times, however, taking a note of the problem and coming back to fix it later is the better option. For example, if you have already agreed a specific time for lighting to do notes, and you have bodies who can stand in for the absent performers – just take the note and don't interrupt the flow of the rehearsal by stopping. You might take a quick digital picture of the stage and note the file name of the picture, the cue and the problem.

If you have a competent programmer, and you know your rig well, many smaller 'fixes' can be done in the moment, without any need to stop the rehearsal or come back to the cue state later.

Enter the programmer!

What is the difference between an operator and a programmer? Lighting consoles and the fixtures (and other equipment) they control can do more every year. More is expected too, by audiences and by lighting designers, directors and producers. The lighting programmer – a lighting person with an expert level knowledge of the lighting console and the lights it controls – has become an essential member of the team on larger shows, and very useful even on smaller shows. A programmer usually only works on the show while it is still developing – that is from the period of the technical rehearsals through to the opening night. An operator is employed to run the show every night, but usually has less expertise with the console than the programmer.

Some LDs program their own shows. Most people seem to agree, however, that an LD is paid for their eyes and how they see the stage. Many key strokes and other adjustments are needed to get a substantial number of moving lights into the right place at the right time. The eyes of the programmer will at times inevitably be focused on screens and keypads rather than the stage. The programmer's brain will be focused on the best technical way to enable the latest lighting state onstage rather than on the dramaturgical reason for that lighting state, and what it looks like. Very few people can successfully accomplish the two roles of organizing and entering data and designing lighting states simultaneously – the novice should not attempt it. Therefore as an LD, as soon as you start working with moving lights, you are strongly advised to try and find yourself a competent lighting programmer!

Making cue states

Whether you are working with a programmer or plotting the show yourself, it is most likely that you will be creating cue states and transitions onstage and recording them in such a way that they can be repeated reliably for every performance. With that in mind, here are some tips to make this often challenging process a bit easier.

Cut and paste

Very often, we want to use the same basic look or transition more than once. For example, we might have several scenes set in the same location at the same time of day (or a location where time of day does not affect the light). Or we might only want to use selected channels from a scene, say the channels dressing static scenery, or perhaps a particular cyc look. It is common practice to copy the channel levels (and attributes of automated lights) and paste them into the other

cue or cues, either as a basis to build on or as a finished cue. It is important that the programmer understands exactly what the LD wants to do in these cases as there are usually several different ways of working on modern lighting consoles, and each may have slightly different results. Approaches include:

- Copying a whole cue, and pasting it into the new cue, either with or without the associated timing information. This can result in unwanted information in the new cue, such as positions of moving lights that are not actually used, and is usually the least satisfactory way of working.
- Copying only the active components of the cue – intensity channels above zero and the status of any associated automated lighting attributes. This is usually the most flexible way of working, but may not be the easiest for the programmer on some consoles.
- Storing the intensity (and other attributes where appropriate) of the channels frequently used together as the whole or part of a look, as a focus palette or set of palettes (or equivalent). This means that any change to the focus stored in the palette will automatically update all the cues that have used it as a basis. This probably means the fewest number of buttons need to be pressed by the programmer to get the look back onstage.

Since copying cues and pasting the contents into new cues can be an extremely efficient way of working, it is something every aspiring LD should investigate the particulars of on the consoles they will be using.

Tracking

While we are discussing making looks and recording cue states again we should talk through the pros and cons of the two most common ways of recording cues in lighting consoles – tracking and cue only. In essence, the difference is clear:

- In cue only the console records the output of every channel in each cue.
- In tracking the console records only the changes from the previous cue.

Why the difference? The first computer consoles had very little memory, so many manufacturers made a virtue of necessity and maximized the usefulness of that memory by storing changes rather than whole cues. After all the guys (and they were mostly guys) who recorded by hand the cue information for the manual boards of old were only interested in what they had to change, so that is all they recorded on paper. When memory became cheaper, some manufacturers allowed their consoles to record everything with every cue, and for a while many of us thought this was no bad thing. Admittedly it did bring a few problems. Imagine a show has a big sky cloth and we run a long cue simulating a sunset using cyc floods. Then a performer pretends to operate a light switch and we have a second cue that quickly brings up some channels to simulate a desk lamp going on. So long as the sunset cue has finished there is no problem. But if the performer is early and operates the light switch *before* the sunset cue has finished, the cyc channels would jump to their final state with the 'Go' of the desk-lamp cue. This is because when the desk-lamp cue was recorded the console took the level of *all* the channels including the cyc ones, and stored them, so the cyc channels were recorded in their final state. When the desk-lamp cue was played back, the console told *all* the channels, including the cyc ones, to go to the values they were at when the desk-lamp cue was recorded. If the same cues are recorded in

tracking mode, only the changes in the channels associated with the desk lamp are recorded in the second cue. The sunset cue will continue to its conclusion in its recorded time no matter when the desk-lamp cue is taken. Some lighting consoles that record all channels in every normal cue have work rounds such as the move fade, but when we start to use moving lights and scrollers on these lighting consoles things can get difficult.

With tracking it is possible to record the position and other attributes of a moving light at the beginning of a scene in which it is used and then focus only on the attributes that change during the scene. If the intensity changes from cue to cue that is all that will be recorded in these subsequent cues. If later we decide that the beam was too small for the scene, we only need to change it in the first cue and it will be correct for all the rest. This may seem like a small thing when you only have a few moving lights and you are using them individually. Once a lighting system becomes dependent on moving lights, the increased speed and other advantages of tracking make it the only logical choice for most working LDs.

What tracking allows us to do, as well as running several cues at the same time without them affecting each other, is to simplify the business of using moving lights in a theatre style play-back or stack of cues. The detailed implications of working in tracking mode are primarily the concern of the lighting programmer[12] and in any case will change from console to console. However, here are a few things the LD needs to consider when working in tracking:

- Two or more cues controlling separate selections of channels can run simultaneously without affecting each other – the sunset will carry on to its programmed conclusion in its programmed time no matter when the desk-lamp cue 'Go' is.
- The channels that don't change throughout a scene, for example channels involved in lighting the setting, only get recorded once in the first cue of the scene – if halfway through the rehearsal of that scene we want to change the look for the whole scene, we only need to update the first cue and all the rest of the cues will look right too.
- It should be simpler to see on the console display what each cue is actually doing, since the channels that change will be highlighted in the output display.
- It should make cutting and pasting lighting cues and parts of lighting cues a lot simpler. Moving light and scroller positions associated with intensity channels at zero will not be in cues we copy from, and so we won't end up with unnecessary noisy and distracting moves in the pasted cue.

Blocking cues

Tracking can sometimes lead to nasty surprises, especially if there is a need to record cues out of sequence. For this reason and others, we frequently use blocking cues. A blocking cue includes every patched DMX channel, including every attribute of every moving light. It means that any changes made to cues before the blocking cue in the cue stack will have no effect on those after the blocking cue. In multi-act drama or opera, for example, it is a good idea to record the first cue of each act as a blocking cue.

[12] Good books on this subject include the *Automated Lighting Programmers Handbook* by Brad Schiller and the comprehensive *Automated Lighting* by Richard Cadena.

As with the details of the options available to cut and paste, getting to grips with tracking as implemented on the consoles you use regularly is something every aspiring LD should do.

Transitions and cue times

As well as consideration of the finished lighting state, we also need to think about how we get into that state and how we get out of it – hence transitions. Let's begin this discussion with some definitions of cue types:[13]

- Snap cue — A jump from one lighting state to the next in the fastest possible time.
- Normal cross-fade — A transition from one state to the next where the intensity of some channels fades out at the same rate and starting at the same time as the other channels increase in intensity.
- Split-time cross-fade — A transition from one state to the next where the channels associated with the new cue state move at a different rate to the ones fading down from the old cue. Usually represented as UU/DD where UU is the time taken to build the new state (up time), and DD the time for the old state to fade out (down time).
- Delay time* — Used when the fade-in and fade-out *start* at different times. The delay time is the gap between the action of pressing 'Go' and the delayed fade-in or fade-out beginning.
- Follow-on cue — A further cue that happens at some point after the first transition has begun. It will often start when the first cue is completed, and may be triggered automatically (auto-follow).
- Wait time* — The time between pressing 'Go' and the cue with that wait time beginning – most often used with follow-on cues. Some consoles take the wait from the end of the first cue rather than the 'Go' of the first cue!
- Link cue* — A cue that changes the standard numeric order or cues in a stack. It may link around cues that are not required, but that you don't as yet want to delete, or may be used to create a loop of cue states to form a chase. Does not usually have any channel information.

[13] See also the boxed section on cue time in Chapter 5.

- Part cue* A single cue in which different channels or groups of channels move with different rates and /or have different delay or wait times.

*Warning: some console manufacturers use these words in different ways, and some use different words – always check if you are at all unsure.

Complex rigs of moving lights can require cues with multiple timings. For example, imagine a cue where some moving lights required for the next cue pan tilt and change colour ready for that cue – but very slowly in order not to cause a distraction – at the same time as other channels snap on to mimic the effect of a light switch being turned on; or the fade-up of some units with scrollers being delayed for a few seconds while the scrollers change to the correct colour. For a dance number (or for other reasons) we might want each of say six moving profiles to sweep from upstage to downstage. Instead of them all moving together, we might want the first to set off, and as its beam gets to mid-stage for the next one to set off, and so on. And then we might want the later ones to move more quickly than the first few – to catch them up so to speak. If we also decided that these lights would change colour in sequence as they moved downstage, and perhaps intensity too, we might be looking at up to 36 different values of fade time and delay time for just these six lanterns in just one cue! If we were using part cues, this could be a 36-part

The mark cue

Mark cues are particular to moving light consoles – and again the name comes with a warning: Different console manufacturers call it by different names, and implement it slightly different ways. Generally, the 'mark' cue is a special cue that the console itself calculates the contents of. A mark cue is an auto follow-on; once the cue before it has completed, the console will automatically trigger the mark, which should have no effect on the lighting state onstage. Once a mark has been placed in a cue stack, the console will 'look ahead' to the very next cue. All the moving lights or lanterns with scrollers that

- are at zero intensity in the current cue, and
- are on in the next cue

are moved into position ready for that next cue – correct colour, beam, focus position, etc. If any change is made to the 'next cue' these changes are automatically reflected in the mark cue. This function is very powerful when it is properly implemented in the software of the console and understood by the programmer. On good moving-light consoles, the mark cue or equivalent can be given its own time – so if things need to be got in place quickly they can, and if they need to be moved slowly to reduce noise or distraction, they can do that too.

Some consoles have a global function that puts moving lights and scrollers into position automatically with a global time. This can be useful during technical rehearsals because it will (usually) avoid unwanted sweeps of movers or scroll changes while the lantern is on – called 'Live Moves'. However, the feature is rarely flexible enough to deal with every preparation cue discretely and a good programmer will strive for the added control afforded by an approach tailored to the individual cue state and taking account of the context of the show, e.g. is this a noisy or quiet part of the performance?

cue. Most contemporary moving light consoles, however, allow the programmer to do this in ways that are much easier to see and to edit.

Snaps

A transition between two lighting states that has cue time of zero – a snap cue – will clearly have a very different effect than the same transition with a longer time. The shock effect of a sudden change in intensity (or colour or beam for that matter) draws attention to the lighting. If there is an obvious cause for the change – a performer switching a light switch or the sound effect of thunder – then the motivation for the change is clear, and the shock effect is diluted. (After all our audience is used to sudden changes in intensity resulting from operating a light switch.) A snap cue that does not have such an immediate physical motivation[14] is a powerful signifier – usually provoking an audience response along the lines of 'what was that?' as the audience searches for the cause. It can be like a metaphorical slap for the audience, and so snap cues need to be handled with care. It is worth spending some time to make sure they happen in exactly the right place in the show every night.

One specialized use for the snap cue is at the end of musical numbers, where it is called a 'bump'. A well-executed bump signals 'applause' to an audience used to American and British musical theatre. It is part of the language of the genre. There are many ways of executing the bump cue. For anyone wanting to light musicals, this is just a small part of the language to be learned from observing the work of acknowledged experts. It is said that a well-executed bump can wring applause out of the audience – even if the musical number itself is indifferent.

Cross-fades

A cross-fade that, for example, shifts focus from one stage area to another will have a different impact depending on the timing of the transition. It is important to be clear about what the performance is trying to achieve at that point if the lighting is to support it. For example, in a two-room stage set, if our intention is to transfer attention from one room to another in a clear and obvious way, a simple relatively rapid cross-fade will probably be appropriate. On a more open stage we may want to make the audience slowly aware of some developing action away from the current area of focus, and then once that new area has established, reduce the focus on the original area. We can do something more ambitious with timing the transition here; perhaps a slow build on the new area over say 20 seconds, and as this is establishing a slightly quicker fade out of the original area. This might be represented in a cue synopsis as Time 20/10 Delay 15 – meaning a build over 20 seconds, followed 15 seconds into that fade-up by a 10-second fade-down of the original area. On a simple timeline it looks like this:

Seconds	0 1 2 3 4	5 6 7 8 9	10 11 12 13 14	15 16 17 18 19	20 21 22 23 24 25
New Area	Build starts			Complete	
Old Area				Fade starts	Complete

Figure 3 Timeline of a split-time cue.

[14] Remember the maxim from Chapter 5 about lighting cues being like method actors and needing a motivation.

If we wanted more subtlety, we might establish the new area in parts – first bringing in the back-light to reveal a silhouette, then a key from the side with matching fill to reveal a more three-dimensional form, and finally a special to reveal a hidden performer. If we did this with a part cue, the timing and notes might be written down like this:

Part No.	Time In/Out	Delay Time	Notes
1	20/20	0	Back-light & Cyc in New Area
2	15/15	5	Add Key
3	10	15	Add special for 'Alex'
4	20/20	20	Lose much of Old Area

Figure 4 Example of a four-part cue.

Let's look at this on a timeline:

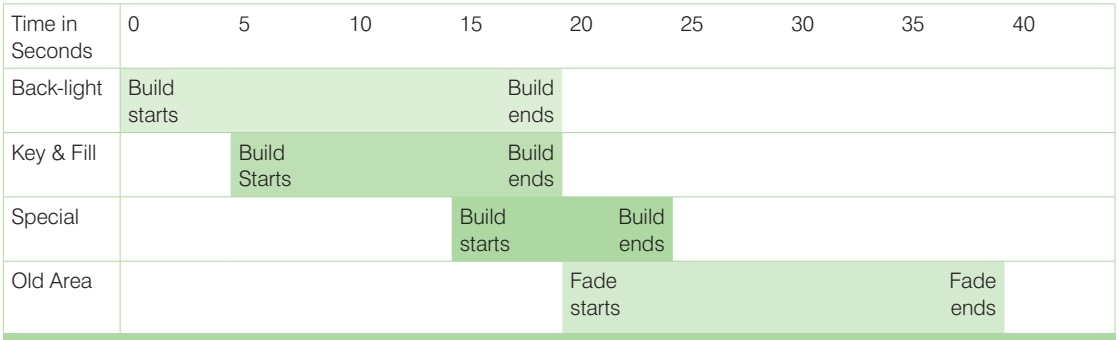

Figure 5 Timeline representation of the same four-part cue

Recording this kind of transition as a part cue is not the only solution. If the lighting console is working in tracking mode where changes associated with each cue can be more or less unaffected by other cues running at the same time, each build or fade can be a separate cue state. We can set up the console to make the first cue – the back-light build – trigger the others automatically after the programmed wait time, or we might have each cue triggered by separate hits on the 'Go' button, allowing the operator or show-caller to judge the best moment to begin each stage of this reveal in response to the small differences in the timing of the performers from show to show.

Playing with the passage of time

Very often in performance we are manipulating time: the time of the piece may or may not run at the same pace as the time of the audience – hours may pass in stage time in the seconds of a

transition. There are ways the timing of our lighting cues can either support or undermine this. For example, we have mentioned already that simulation of the changing position of the sun in the sky can be a way for lighting to indicate passing of time, and how this may often go unseen by an urban audience no longer used to judging time by the position of the sun. However, if we allow the key source or sources to lag in the fade-out and lead the build into a new lighting state, the strong shadows will be more present for a while, and more available to signify time of day. Another example might be a transition into a dark night-time state. This might begin with little light and the audience struggling to see, and then follow on with a very slow build that brings just enough light to make visible the key performers by the time they are saying or doing important things.

Time onstage may or may not be linear – the piece may include flashbacks or scenes from other specific or non-specific time periods. Usually lighting will play a big part in signalling of slips in time to the audience. Key-light angle or colour may be used to signify unnatural time or place, but so can fractured transitions accomplished using part cues. We are in the territory where performance lighting draws attention to itself as conscious signifier – which means we need to be especially rigorous in our approach. Once a language has been established that works for the piece (which usually means also that it is coherent with other signifiers on the stage) representation of nature can become less necessary – so long as the lighting is still supporting the production.

Constraints of genre will need to be considered. If the piece is a conventionally presented play in a naturalistic box set[15] it is unlikely the audience will read a fractured transition as anything other than a technical mistake. If we are making a musical in the West End/Broadway tradition, the audience will expect there to be enough light to see all the faces (almost) all the time, but will probably be accepting of quite a lot of unnatural coloured light. If the genre is large-scale opera, very often light can be a conscious and overt signifier, while in the world of classical ballet functional revelation of the dancer's form is the prime consideration.

Cue points and cue placement

In general, the shorter the transition the more critical is the cue placement. While we can often be quite flexible about exactly when a five-minute cross-fade in the cyc colour starts, the bump cue at the end of a musical number *has to* 'Go' in exactly the right place. While many cues have a defined place where we need them to start, some need to finish on a particular point – for example a long cue that might close the stage down to a single spot at the end of a ballad. Others need to 'bite' at a particular time, say a slow fade-up that only starts to do its job some seconds after the 'Go'.

It is important that this kind of information – if you like the *intention* of the cue – is understood by the person who will be operating or calling the show, otherwise it's unlikely that it will happen consistently. It's part of the LD's responsibility to make sure this happens. We do this first by clearly communicating the intention of important

[15] Box set: a naturalistic representation of a room onstage with the 'fourth wall' and often the ceiling missing to enable the audience to see and hear what is going on – like the melodrama of previous chapters.

cues to the show-caller and/or operator, and then by leaving clear notes for those who run the show after you leave.

Making use of rehearsal video recordings

Sometimes there is just no possibility of working fast enough to program all the required cues in a particular section of a piece. Maybe there is an intricate dance number where the design idea is to both follow the rapidly moving centre of action of the piece and change the 'mood' of the light to follow the mood of the music. Sometimes the LD is simply told that it is too dangerous to 'light over' a particular rehearsal, and it will happen first in bright work-light. Maybe there is a complex scene change involving a number of flown and trucked elements breaking apart and re-forming. The first stage rehearsal of this kind of activity is unlikely to be the right time to try out lighting states and cue transitions. All concerned are likely to want to perform difficult or dangerous transitions in an evenly lit space without having to worry about performance lighting, perhaps blinding, perhaps plunging into unexpected blackout.

One response to this is to take a break and come back when the others are sufficiently prepared for lighting to continue. Another response is to take a video recording – preferably including the show-caller's cues on one of the soundtracks for reference.[16] The lighting team can then record lighting states and transitions with the video and the show-caller's cues as a reference. This technique can work really well for dance numbers requiring a lot of specials – especially if the video images enable the lighting team to see where onstage each special needs to be focused. Generally speaking, dancers are good at hitting the same spot of stage every night, so specials can be tight – and if you discuss ideas with the choreographer, together you can both make tightly focused, precise and effective work.

When it comes to making best use of a lighting session, having a video reference for scenes goes a long way to compensating for not having the performers onstage. At least you know where they were in the rehearsal, and at what moment.

These days it is possible to record a rehearsal directly onto a smartphone or the hard drive of your laptop on the production desk. This can be very useful for fixing cues – re-focusing the moving light to where the performer actually stands, or moving the position of a cue a few lines to go with a particular move. The quality will not be great, and the colour will be nothing like real, but think of this as a video notebook – one of a set of tools that will help the LD make the lighting the best it can be by opening night.

Getting through to the end

Technical rehearsals can be highly stressful for all concerned, so it's a good idea to prepare yourself well. Alongside all the technical and creative preparation, try to be physically and emotionally prepared too. Things like getting a decent night's sleep beforehand and eating healthily may seem to be low priorities compared with finishing the focus and having a great understanding of the piece you are about to light, but they are often just as important to making good

[16] You will need to check that everyone is okay with you taking a video, as people can get quite touchy about unauthorized recording. Be clear why you want to make the recording, what you will use it for, and be prepared to hand over the file or tape when you have finished with it!

work. Keeping yourself hydrated during the tech can be important too, and I always have my water bottle on the production desk.

Taking breaks is important too – even if you feel there is too much to do, it almost always pays to take a short break and get some fresh (or at least different) air. And try to make sure your programmer does the same. You will both be able to work more quickly and effectively after a break, more than making up for the time 'lost'.

It's important too to get a valid second opinion on how it's going. On a theatre production, be sure to check in with the director whenever you can. They will have lots of other concerns, and you will need to be sensitive to that. Even if things are not going well, perhaps especially if things are not going well, do make sure you are communicating. Even if it's just to explain why it's not going to plan. Sometimes you will find that while you feel it's not going well, they are really pleased. Check in with the other designers too, and don't be afraid to ask them how they think it looks. While you have been stuck behind the production desk, they may have seen the rehearsals from any number of different locations.

Your chief electrician or production electrician can also help you keep a sense of perspective when you are stuck in a scene, by reminding you of the great looks you have achieved or maybe even suggesting an approach that will get you un-stuck.

It's not unheard of for technical rehearsal to run out of time. If this looks like it's happening to you, try to make provision for it. Perhaps cut and paste 'placeholder' cues into a section of the show, to give yourself enough time to light the end well. Perhaps simply copy the same cue that you know 'works' into sections of the show you have not been able to light, knowing that you will come back to 'fix' these sections later. If you trust the operator and it's appropriate, record some 'emergency' looks on sub-masters and give guidance on what to use when (better still, be on hand to directly guide and advise).

Don't forget too that almost every show ends with the performers bowing to the audience and then the house lights coming back on – so make sure you have something in the console for that.

10

Finishing touches

Dress rehearsals

Dress rehearsal shot, with the production desk still in the auditorium

The tech of most productions is a stop-start sort of thing. Everyone is working out how the piece fits into this new space. The LD can make use of these stops to do work on cues, and not only the cues relating to the section of the piece we have stopped at either. Soon though it will be time for one or more dress rehearsals. Now the aim is to run the piece without stopping – as if the audience were there.

The LD should make sure they can still communicate with the show-caller and the programmer during dress rehearsals, preferably from their production desk, so that the LD still has access to their plan or magic sheets, the cue synopsis, and can still see the output of the console on a screen. However, during a dress rehearsal, it is difficult to do much more than tweak the occasional level or time, especially if there are sections with a lot of cues. The LD will need to take notes of flaws and errors, ready to fix them later. In heavily cued sections of a piece, for example a dance number or complex scene change, it is usually more important to make sure the cues are in the right place in the script rather than that the state is perfect – the state can be fixed later when the dancers or scene-change crew are on a break and there is less pressure – hopefully with the help of someone who knows the sequence well or using a video recording of the rehearsal.

Visual dramaturgy

During a 'run', the LD needs to keep concentrating on the whole picture onstage, trying to see it from the point of view of someone who has not seen this piece before. Is what should be visible sufficiently visible and what should be hidden suitably hidden? Is form revealed appropriately through combinations of shadow and highlight, colours and textures? Is the attention of the audience suitably guided to the most appropriate place for the production at each moment of the production (and left to find its own centre of attention where that is appropriate)? Are states that support a particular location, time or mood doing that? Are the transitions working, and do the states work in sequence? This may be the first time anyone has seen all the states in context and to time, with the performers actually performing. It may be the occasion when something that looked great when plotted in isolation looks wrong in the context of the cue states before or after it.

This is the part of the production process where the LD's role as visual dramaturg becomes most important. In the northern European theatre

tradition, the dramaturg is the literary manager of a theatre company. Their role in the rehearsal room and the performance space is to ensure the company's necessary attention to details during rehearsal does not stop the piece working as an integrated whole, and to maintain the integrity of the overall artistic vision of the company. This may sound like rather a grand role for a LD, but consider this: who else is responsible for all the things we have just talked about and why are those things important? Just as the literary dramaturg is most often not the original creator of the text of the play, the LD is most often not the original creator of the visual side of the performance, but both take a responsibility for ensuring the way the piece is presented to the audience 'works'.

We have already said that the LD needs to develop and maintain the visual logic of the piece, working with and enhancing the visual languages of the production. Of course, each member of the design team will also take some responsibility for these things too, and the LD cannot do anything alone. But the fact that the work of the LD is to make visible that which is seen, determine the way in which it will be seen and hide that which is not seen puts a heavy responsibility on their shoulders. When the piece is 'run', the LD needs to be looking beyond individual cue states and paying attention to the developing visual dramaturgy of the production.

Figure 1 Almost ready for the dress rehearsal of *13* by Mike Bartlett, in the Embassy Theatre.

Lighting notes

Depending on how many runs are available to watch and take notes, the LD may wish to concentrate on different things for each run. Perhaps the finished states at one run and the transitions at another, or the stage near the principal performers first and the rest of the look later. This approach acknowledges that there are limits to how much can be achieved, both in taking notes and in doing the 'fixes' with the programmer, show-caller and crew afterwards. As the LD, you will have to make choices and negotiate what can be fixed before the next run, and what can wait.

Often there are details of the design that need the performance to develop in the space before they can be fully addressed. The LD's role as visual dramaturg can be key here in allowing the developing performance to drive the response of the lighting design rather than trapping the performance in a fixed view of what the lighting will do. Perhaps some evocation of mood the

team planned to do with lighting is now being done powerfully by the performers – the LD may need to back off here to avoid overpowering the performance. Conversely perhaps a sense of place and time the director hoped would be conveyed by the script is not coming over, and the LD needs to work with the director and perhaps the sound designer to establish location or time of day.

The LD needs to prioritize. For example, there is usually little to be gained from fixing the lighting on the set dressing in a state where the principal performer remains unlit. The priorities of the production may change from day to day or even from hour to hour. Working to those changing priorities is something that requires artistic sensitivity, technical understanding and excellent people skills – and is a normal day's work for a professional LD.

Taking notes

To take efficient notes, the LD will have to do several apparently incompatible things at once; closely observe the stage, legibly record the 'note' and the cue number or the state the note applies to. On larger shows, this is where an assistant can be invaluable. If the LD's eyes are on the stage, the assistant can be writing down the notes and discovering the cue numbers, either from a monitor linked to the console or by asking the operator over the headsets. When no assistant is available the LD has to work out other ways to take good notes. The strategy adopted will depend to some extent on how many notes the LD thinks they might need to take. If the piece is still quite raw there may be little alternative to watching from the production desk, close to console monitors and a work-light to illuminate a paper notepad or computer keyboard.[1] As the piece becomes closer to the LD's vision of a finished work, fewer notes will be needed and the LD can more easily move away from the production desk. Many LDs become quite good at writing in a notepad without looking at it; use large letters and stick to one or two notes per page on a reporter's style notepad, with plenty of abbreviations and this can be effective. Using a voice-recorder can work well too. The LD can speak the note quietly into the machine, and the background noise from the stage recorded at the same time will help to locate the comment in the piece.

Using a wireless earpiece linked to the show-caller's talk-back channel can keep the LD aware of the current cue number. Apps are available for several lighting desks that allow the LD to see what the lighting desk is doing on their smartphone or tablet. Either way can help the LD decide whether 'mistakes' in the lighting are down to the cue being called in the wrong place, or to 'operator error'; for example the wrong button being pressed at the wrong time, rather than a cue state that needs fixing.

The LD's notes, taken at the production desk or elsewhere in the auditorium, can be a great way of gathering the information required to refine a lighting design – to ensure the focus of the lighting is always in the right place, that there are no unwanted distractions and that the states and transitions support the production. Notes may include changes in level of individual channels or groups, changes in moving light position, beam

[1] The need to write notes while still looking at the stage can be solved in a couple of ways. An LD who can touch type can continue to observe the stage while typing their notes into a laptop. More traditionally, with a little practice many people can write legible notes on a paper notepad without looking at it. This method means notes can be taken even while sitting among the audience.

or colour, and changes in timing – both in the recorded cue times and in the placement of cue points. They might also include notes for discussion with other departments; can a fly cue run slightly slower to aid the drama of a reveal, or a scene be played in a slightly different place to avoid casting a distracting shadow? In some production environments notes of this second kind will be welcomed as a useful contribution to making the show better for everyone, while in others they will be seen as interfering by the LD in matters that don't concern them. Once again, the LD will need to be using people skills to decide the best way of working in each different production situation.

Once the notes have been taken, they need to be acted upon – states re-recorded, times altered, focus positions updated, cue positions changed, whole cues cut or new cues added. During this process, the LD must keep their paperwork up to date (another job for the assistant on those occasions when the LD is lucky enough to have one). For example, to work on the focus of individual lanterns or groups requires a full knowledge of the use made of those lanterns through the whole piece – there is nothing to be gained from re-positioning a lantern to work for a scene in Act Two if by doing so it no longer works in Act One. Likewise, with cue states and timings: if a new cue is to be added, the LD must know where in the sequence of existing states it is needed so that it gets the right number; if a cue time is to be successfully extended there may be other consequences that need to be taken into consideration – is there still enough time for the moving lights that go out in that cue to move while dark to their required positions for the following cue?

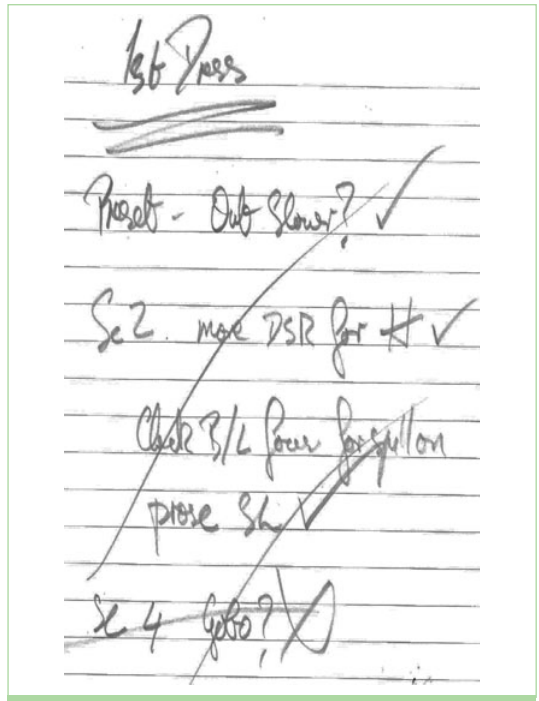

Figure 2 Picture of a page of lighting notes. The notes I have acted on are ticked, those I chose to ignore are crossed out. I try to keep all my notes for a production in a single notebook so I can look back and find hopefully find out why we changed something – for instance, putting more light downstage right in Scene 2. If at the next run, 'H' no longer moves 'DSR in Sc2' I'll know why I have a bright bit of the stage for no apparent reason!

Without up-to-date paperwork – which will include focus plots, track sheets,[2] cue synopsis with timings, script or score with cue positions marked in – the task of refining the lighting will be almost impossible. If all these things are in place, the LD can use dedicated work sessions or 'stolen time' to develop, refine or even completely change the lighting for small or large sections of the piece. In theatre, dedicated time slots for the LD are usually called LX notes sessions. There will be an

[2] These days the track sheet is a screen or printed document produced by the lighting desk showing the level (and other things) for each channel in every cue in the show. An LD can use it to see if a given channel already has a significant role in lighting states, or if it is free to be used for some new purpose.

expectation that general working light will not be used during an LX notes sessions – though other work may be happening in the space at the same time and may need localized illumination arranged by the lighting department. The LD will need to let others know if they intend to use the session to do work with lantern focus or with cue states since different personnel will be required for each type of work. Re-focusing will probably need the whole lighting team (but perhaps not the programmer) while working on states and timings will need the programmer, hopefully the show-caller, and perhaps the director and other designers.

It is usually possible to get an LX notes session into even the busiest production day – but often it will take some organization by the LD and the production electrician. Perhaps the notes session can happen while the stage crew are at lunch – provided they leave the stage set up in a useful way and the lighting department has sufficient staff to provide a programmer over lunchtime.[3] Perhaps it can happen at the end of a call for the performers (who are often given time to get out of costume and make-up before the end of a work session) again provided others cooperate to allow this to happen. The canny LD will be able to give notes even in the small breaks that happen during a rehearsal session – as long as in doing this the lighting department does not hold up the process of re-starting the rehearsal.

The LD needs to record that a note has been acted upon, otherwise time will be wasted looking at cue states that have already been 'fixed'.

The LD needs to be clear about what can be achieved with what can be made available. For example, in a piece with several sets, is it better to have a specific one, or to work on a bare stage? Often this will depend on what is being fixed. If it is about the lighting downstage centre in several scenes or the look of the cyc, perhaps working on an open stage is okay, but if it is about the balance between background and foreground or fixing a focus that currently flares on a set, the full setting may need to be onstage.

Very often the LD works around other activity. The schedule for a day midway through a week of production rehearsals in a theatre might look like this:

8.00 Call for house crew to open the building, turn on systems. Stage department re-set the stage for the morning's work.

8.15 Stage crew begin repairs or modifications onstage under general working light.

9.00 Lighting department begin rig-check.

9.30 Stage department break for breakfast, working light can be turned off while lighting department do half an hour of timing notes or focus adjustments (since the stage is not set with any particular setting, it is unlikely to be possible to do detailed notes just yet).

10.00 Stage department return to work onstage under working light. The LD and the lighting department break for breakfast, followed by preparations for the rest of the day, which might include updating paperwork. The lighting team have an opportunity to address any faults in the lighting system and make

[3] Generally, once production rehearsals begin, LDs don't get as many breaks as their crew – taking every opportunity to work on the states and transitions. This does not mean the LD should neglect their own physical needs such as food, drink and sleep. A tired and hungry LD is unlikely to do their best work, and very likely to become grumpy and short tempered with poor people skills!

any required changes, e.g. replacing blown lamps or burnt out colour.

12.30 Stage department, having finished repairs and modifications and put the Act One set onstage ready for the afternoon rehearsals, break for lunch. Lighting do notes on Act One with reduced crew – probably just the LD, the programmer and one other. The show-running crew will be at lunch, returning for the half-hour call.

13.00 The stage-management team arrive onstage to set up for afternoon rehearsals at 14.00. DSM/show-caller joins the LD at the production desk to update cue positions and timings in 'the book'.

13.25 Half-hour call[4] for the afternoon rehearsal – show crew prepare for rehearsal. Perhaps the LD takes the opportunity to chat to the director over coffee and a sandwich, outside the performance space.

14.00 Run of Act One onstage, LD takes more notes.

15.10 Run of Act One ends, director working with cast onstage, LD working with show-caller and lighting programmer to refine states, cue positions and timings. Some sections may be run again, to check changes in blocking, lighting states or cue timing or for other reasons. At some point there will be a break for the performers. There will be crew breaks to fit in too. The LD will often want to keep working through breaks. To do this, however, they will have had to make suitable arrangements with the head of the lighting department. The LD does as much work as is possible/practicable, remembering to stay in touch with both the director and the head of the lighting department/production electrician.

17.00 End of rehearsal session: Stage department re-set the stage for evening rehearsal, performers and stage management (and some of the lighting department) break for evening meal – another chance for the LD to catch up with the director and other members of the production team, and to eat, while the stage is unavailable for lighting.

18.25 Half-hour call for the evening rehearsal, another chance for the LD to do some notes or catch up with the director/head of the lighting department.

19.00 Run of Act Two onstage, LD takes more notes. The pattern will be much the same as the afternoon rehearsals, with work on cue states continuing over the rehearsal and during breaks onstage.

21.30 Performers leave the stage to get out of costume and perhaps receive their notes from the director. Stage management may be available to work with lighting to facilitate a short notes session for the LD before . . .

22.00 End of the formal working day (for most departments). It is likely that formal and informal meetings will continue with the production team and others, reflecting on the day's work and planning sessions for the coming days. Engineers, scenic artists or others may take over the stage to do their work overnight. There may be

[4] In the British tradition, all calls to prepare for the show are timed to five minutes before scheduled start time. In this system, zero is the 'beginners' call.

an element of this that involves the lighting department, in which case a night crew will need to be briefed.

By making the necessary arrangements the LD has secured some dedicated lighting time; the late morning session with the set onstage, away from the pressure of rehearsals with the performers. This session happens after the lighting team have had an opportunity to fix or adjust elements of the lighting system and get it working well, and some of the session can happen with the show-caller – making sure times and positions of cues are correctly recorded in 'the book'. An hour is not a lot of time, especially with a complex show, so the LD will have to work with the head of the lighting department to ensure the lighting team are focused and ready to work quickly when required.

The LD is also able to make use of short periods of unscheduled time too. During the day, time can been found to do more fixes or adjustments to the focus or colour of individual units (perhaps during the performer's breaks), to talk with the show-caller and adjust cue placement and timing, to work with the programmer and adjust recorded states and times, and to talk with the director and other members of the creative team, to make sure everyone's goals for the piece are still coherent. And time for a little food and drink too.

Notes from the director, set designer (and others)

As we have said many times, making performance is about collaboration, and that involves taking on board the opinions of others in our work. The director will usually have opinions about the lighting, and not all of them will be complimentary all the time. It is quite likely that the designers will also give notes on the lighting design. If there is good communication between the LD and the rest of the creative team, these notes and comments will be part of the dialogue that informs the development of the piece – the evolution of the visual dramaturgy alongside other dramaturgies. However, when communication has broken down the LD may find themselves blamed for anything from the inaudibility of some performers to the dull colours of the costumes. Lighting has even been blamed for a whole piece not working. (If only the acknowledgement that sometimes a piece only works because of the lighting was more common.) An LD needs to listen to the comments and complaints of their collaborators, and then decide what to do with the information these notes contain.

The trouble is that much of the language used by an experienced LD to describe their work is quite technical and precise – non-specialists often use much less clear language when they talk about light in performance. When a creative team have worked together on several productions they will have developed an understanding of what each means by what they say. But even between members of experienced production teams there will be plenty of scope for miscommunication. We have already mentioned the potential for misunderstanding inherent in the use of the terms 'warm' and 'cool', and between 'silhouette' and 'shadow'. It does not stop there. Often the best way for the LD to approach these situations is to show collaborators light onstage. In meetings away from the stage, however, this is not possible, and even with the stage in front of the team, there are times when it seems director and LD are talking in different languages.

The people skills of the LD may be tested to the limit. What does the director mean by saying something like 'Is the sky too blue in act one?' This note could be about the colour in the cyc floods lighting the sky, but it could just as easily be about the intensity of the cyc, or the balanced between the cyc and the rest of the stage, or it could be a

reaction to the 'warm' look onstage in front of the cyc at that moment.[5] The note could also be a way of saying; 'Didn't we talk about having clouds in Act One? Where have the clouds gone?' The note could be something the director is really concerned about, or something said more or less in passing, because the director was trying not to think about the leading man forgetting his lines again.

It is not always a good idea to respond instantly to every note with a change in the lighting. Some notes need interpretation and some need further discussion. Notes that impact on the LD's key ideas may need to be challenged in a way that is appropriate to the production situation and the relationship between LD and director. The LD may find themselves needing the support of all that dramaturgical research into text and context that first informed the design, and the support of other members of the creative team too – and may still not win every time.

In theatre, generally speaking, the director is 'boss' – what they say goes. As a member of the creative team behind a production, the LD may sometimes need to close their eyes during a particular scene because the director insisted on their own aesthetic over that of the LD. Hopefully this will be a very rare occasion, for the proficient LD is just as good at persuading others of their vision as they are at creating it onstage. In lighting design, as in the rest of life, we all need to choose the battles we fight with grim determination and those to withdraw from gracefully.

The last days before opening night

Many theatre productions and other kinds of shows have a run of several preview performances before the official opening. The piece is played in front of a paying audience, but is acknowledged to be still developing, and the ticket price is lower as a result. The LD is usually contracted to watch these preview performances, taking notes and working with the rest of the creative team to refine the production. In the world of live music touring, the big name LD watches the first shows bed in, before leaving the lighting director to run the rest of the tour.

Generally speaking, this is not the time for major changes to the design, and the LD needs to spend time polishing what is there, not dreaming of what they would like to be there. We may not be able to move the entire front of house lighting rig to compensate for the fact that every key scene now takes place on a platform mid-stage, as opposed to the many places onstage where they were originally set. Nor may we be able to replace all the profile moving lights with CMY wash lights which seem far more appropriate now that every planned gobo look in the piece has been cut. This can be hard to come to terms with, but at this stage in the production, life for the LD becomes about achievable goals. However, there is no reason not to push for as much as can be achieved. A few well-chosen front-of-house lanterns moved, and their levels carefully re-plotted in the appropriate cues, some underused moving profiles removed and a couple of CMY wash-lights introduced to provide a 'kick' to key scenes; both may be possible with enough negotiation and planning.

There will be a lot that can be done through balancing intensity and colour, and tweaking timing, but sometimes these small adjustments will have unexpected results. Performers and/or crew may be taking lighting cues as their personal cue – 'When the moving light goes red I prepare to

[5] Remember the subjectivity of our response to colour – our perception of the colour of a particular element depends on other colours in the whole visual field.

enter – and tonight it didn't go red!' Another example might be the need to introduce backstage working light[6] as a result of reducing the intensity of some scenes or reducing the area of stage that is lit; both of which would result in less 'spill' light in the wings, which might in turn make preparing for a scene change more difficult or compromise a quick costume change. In a way, that is why these shows are previews. Once a show is up and more or less running, it can become a complex interlinked machine, where even small adjustments to one element have knock-on effects on other seemingly unconnected elements. The LD needs to make sure that there is time to try out changes (especially if they involve moving lights) and make sure they don't have unexpected consequences further down the line.

Opening night and after

There comes a point in most productions where the LD needs to be able to say their work is complete. The lighting design may not be what was originally conceived, it may not be something the LD is completely happy with, but time has run out. The show opens and hopefully everyone is still talking to each other, and the next night it is someone else's responsibility to maintain the lighting design and make sure the lighting works as best it can to support the performance.

For long running shows, the head of the lighting department will usually take day-to-day responsibility for maintaining the equipment in a proper state to keep the show looking as it should. This person may take some responsibility for making small changes to the cue states or timings to accommodate changes in the performance. Hopefully these changes will be sympathetic to the original lighting design. This is more likely to be the case if the LD has been able to share their vision with the team looking after the show. On a long-running show, the LD will usually be paid a royalty. This ongoing commitment will usually include an agreement to come and watch the show from time to time and then work with the resident team to do LX notes.

For shows in repertory – that is when several shows play on the same stage in rotation – the lighting rig will have to be re-focused to each show as it comes back onto stage. In these situations, it is normal to have a designated member of the lighting team take responsibility for ensuring the show looks as good as first night every time it is played. The same thing frequently happens when shows tour from one venue to the next. A designated member of the lighting team takes responsibility for ensuring the quality of the lighting design is maintained. This requires a good level of paperwork to support the lighting design, including accurate lighting plots, focus plots, stage-management cues lists and console cue sheets, and the lighting console memories and other data, stored and backed up securely.

Sometimes shows have another life. If a production is particularly successful, it may be re-produced in another city or country. It is usual for the LD to oversee the lighting of the new production, though they may send a trusted associate in some circumstances. Whoever goes, a re-production is something that will test the accuracy and completeness of the lighting paperwork. Is the focus of every element of the rig fully documented so that it

[6] It would not usually be the direct responsibility of the LD to ensure the show running lights – usually low-level blue light in the wings and immediate backstage area – are fit for purpose. This is most often the responsibility of the stage-management team who run these areas, and the house LX team. Members of the lighting team will work with stage management to get the right units in the right places. However, it is a good idea to keep an eye on what is planned, since light escaping from the wings and other backstage areas can have a detrimental effect on the lighting design.

Figure 3 Opening night curtain call for *13* at Royal Central School of Speech and Drama. Directed by Dan Bird, set by Ruben Speed, costumes by Carmel Hall, lighting by Lauren Woodhead, video by Santiago Martinez, sound by Joe Dines. The gesture to the back of the auditorium is a way for the acting company to share their applause with the design and technical team.

can be re-produced in the new city? Has what the unit does been recorded so that if the throw is different, suitable adjustments can be made? Are all the cues correctly copied to the new lighting desk, and all the cue positions correctly recorded in the new 'book'? On top of this, there is all the supporting production lighting paperwork, equipment specifications, patch, colour and gobo calls, power and dimmer requirements, and much more. Keeping track of all this information is where dedicated lighting design support software really comes into its own.

Then there is the matter of changes to the production, both technical and artistic. Equipment design may have moved on or the equipment used on the original show may have proved to be unreliable on a long run. Artistically the director and/or writers may have developed ideas, written a new ending or just cut a few verses from a song. All these factors will need to inform the modified lighting design.

Even if the show has no afterlife, for all kinds of reasons the LD may wish to keep records of it, including: production photographs and favourable reviews for a portfolio, a scrap book, or a personal website; notes of particularly successful (or even unsuccessful) colour combinations for future use (or to avoid); rigging positions and other specifications of a space that you might work in again. There is also the personal stuff from any production – new friends made, new restaurants discovered and perhaps some reflection on how well the whole thing went, and what has been learned.

11

Beyond opening night

Reflection and building a career

Figure 1 One of a number of 'moonlight' scenes from *Bullie's House*.

How well did what I contributed help to achieve the intention of the playwright, the director, the performers?

How well did I achieve what I wanted? What I had promised?

What did I learn from that show? What would I do differently next time? Everything from choice of colour and instrument to the way I communicate with the actors and the stage manager.

How can I go about building on what was achieved here, and learn from any mistakes?

How did we do?

How does a working LD think about how to get a better result next time? The rest of this chapter is about just that. The things mentioned here though are not meant to be exhaustive, and not everything mentioned will apply to every production. This is a starting point only.

As a starting point for this exercise, I'll try to map various parts of the job of producing a lighting design against each of the three areas of skill – that is technical skills, artistic skill, and what usually gets called people skills or soft skills.

Phase 1: from first contact to the fit-up

Let's look at some of these areas of the job in detail, from the point of view of an LD who has just opened a show. Remember that what we are trying to get out of this reflection is a way to do better next time. This might be to produce better lighting, but it also might be to have more fun doing that, to use time better, or to build better relationships with the people we work with and to build a career. The reflection is not there just to congratulate the LD on a job well done, to vent spleen at poor treatment by management, or make excuses for why we did not achieve all that we wanted to do.

The job starts with the first enquiry; perhaps the LD approaches the producer, or more

likely the set designer, director or the producer approaches the LD. The concept is discussed, dates and availability are checked, fees may be mentioned. This is the beginning of *negotiating a contract*. The contract may be a completely formal document setting out in detail everything about the LD's role on the production. Much more likely it is an outline agreement, setting out dates – for example for submission of plans and equipment list by the LD, when they are expected to be on site or in rehearsal; and terms of payment – for example one third of the fee on signing the contract, one third on submission of a lighting plan and one third on opening night.

Equally important for the LD is the informal side of the contract: What resources are available, in terms of time, budget and staff? Who are the key personnel in the lighting team – chief, production electrician, programmer, follow-spot operators and others? Who is the show-caller? What dates are they each contracted for? Where are rehearsals going to be and when will they start?

This is only touching the surface of the negotiations undertaken when an LD takes on a production. For leading LDs, other details, such as hotel accommodation, travel and subsistence allowances, may be negotiated by an agent or manager. For most working LDs, however, these negotiations over the non-contract terms and conditions must be handled personally, with the producer or production manager, probably in an ongoing way.[1]

Reflecting on the contract and other negotiations

On the morning after the first night, looking back on these discussions, an LD might ask:

- How good was I at asking for resources? Were there things I should have asked for that I forgot about or did not know about?
- How good was I at getting the resources? Did I ask the right people at the right time? Did I accept 'no' too easily or did I make a fuss over things that I didn't really need – with what implications?
- Did I accept contract terms I could not really live with – such as an early date for submitting a plan, an unrealistic budget restriction or inadequate accommodation?
- How happy am I that the fee paid reflects the work done?
- Were there any disputes resulting from different interpretations of terms in the contract?
- How well did the management stick to their agreements, and how well was I able to stick to mine?
- What will I ask for next time that I did not have this time? What will I reject next time?
- What is worth fighting to be put in writing, and what can be left as a verbal agreement?

Many of these questions, and especially the last two points, have been major topics of discussion between all kinds of professionals working in live performance. One way of generally improving the working conditions of LDs and others is to share information about these things and other creatives. In the UK the Association of Lighting Designers provides a forum for this kind of sharing, with the object of raising the profile and status of the performance LD.

[1] The Association of Lighting Designers currently provides advice on contract terms and suggests a rider for contracts for LDs. More information at www.ald.org.uk.

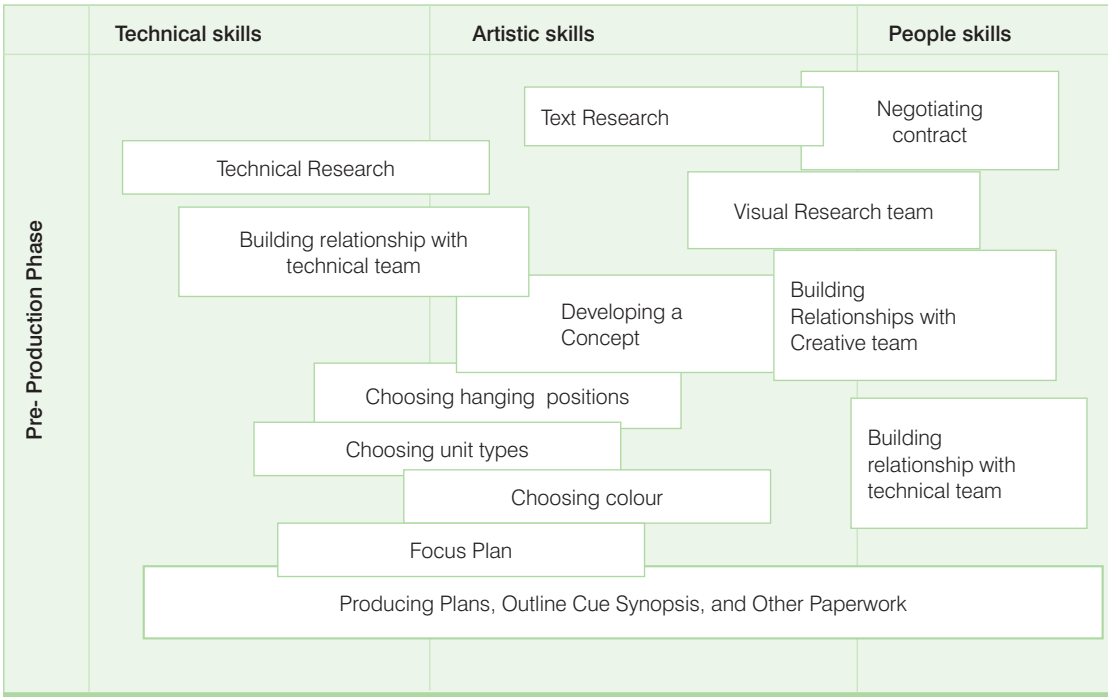

Figure 2 Pre-production activity. This is my version of where each of these activities goes. What does it feel like for you right now? As you become more accomplished as an LD ask yourself, 'How has this changed for me?'

After the agreement to work on a project has been made, next comes *research*; into the text and/or the music, into the people we are going to work with, into the technology we may be using and into visual images that might usefully feed the design concept. Here are some more questions that might be helpful:

- To begin, did I ever have to ask 'What happens next?' during the tech, slowing down the creative process and undermining any confidence the director might have in my knowledge of the piece?
- How good was my analysis of the text/music? Did I read the text/listen to the music early enough? Did I really know the stories, the themes, the sub-plots and other details?
- How about the context of the original work? If the piece is not original, did I research the original? If I did, was that useful, and if I did not, should I have?
- How good was my visual research? (And how am I measuring that?) Was I able to bring appropriate visual references to discussions and use them to inform my design?
- What tools am I using for visual research? Am I making the best use of these? Could I use different ones? Are there galleries or collections I found useful/useless? Why? Was I able to make use of my own drawing or photography? Or my own visual experience?

- Am I expanding my own stock of visual reference or continually falling back on what I already know?
- Am I expanding my technical knowledge? Did I try out anything new? Did it work? If it didn't, should I have known/could I have tried it out somewhere else first?
- Am I relying on others to inform me? (Could be waiting for the director or set and costume designer to give me keys to the text, or my chief to tell me about how I can use some unfamiliar unit type.) Is that okay (this time)?

This last question may be uncomfortable to ask. However, in part it acknowledges that as a single human being with only 24 hours available to you each day, you can't do everything. There will be times when it is entirely appropriate to take the research of the director and set designer as the basis for a lighting design, just as there will be times when it is appropriate to trust the production lighting chief to specify equipment that they know will work for you. All I would say to aspiring LDs is: don't let this become the only way you work.

We have said a lot about building relationships, developing the concept, and making choices earlier in the book. Your reflection offers you an opportunity to examine how effective your current strategy in each of these areas is. What (if anything) needs to be improved, changed or learned from scratch? Rather than a set of specific questions in these areas, think about using one of the following tools.

The first is to look at strengths, weaknesses, opportunities and threats, using a simple tool called a SWOT analysis. You might take an element of your practice – say equipment choice – and analyse what are your strengths and weaknesses in this area, and what are the opportunities and threats presented. Table 1 gives an example.

Table 1 SWOT analysis: choosing equipment

STRENGTHS	**OPPORTUNITIES**
I have a good knowledge of beam angles of a range of lanterns commonly available in the UK and a fair knowledge of a limited range of moving lights.	I can use my present knowledge base (and contacts) to offer myself as assistant to an established LD. I can build on my existing knowledge while working as assistant to an established LD in the coming months.
WEAKNESSESS	**THREATS**
I am not comfortable assessing when and how to use zoom fixtures. I have a limited feel for how much usable light I get from some types of lantern.	I feel like I'm likely to make mistakes in equipment selection, which could lead to poor results. This might also damage my reputation, meaning I get less work on my own account or as an assistant.

We can see from this simple case how difficult it is to treat any specific task in isolation, especially when it comes to the consequent opportunities and threats. Here, for example, a lack of knowledge in one area – the relative usable intensity of different types of lantern – raises a perceived threat to progression in the chosen career. This type of analysis can highlight threats, but will only be useful if the result is acted upon. For example, in this case, work on getting a better feeling for the amount of usable light produced by the lanterns in common use – perhaps by doing some work focusing from behind these lanterns – before the next design job leads to more mistakes.

Another approach available to any practitioner wanting to reflect on their practice is stop/start/continue. An example can be seen in Table 2.

Table 2 Stop/start/continue: building professional relationships

STOP	START	CONTINUE
Relying on calling everyone 'darling' because I don't know their name. Being so keen to defer to the opinions of others, even when I have done research to support a contrary opinion. Taking everything said in the pub at face value.	Taking better notes of everybody's names. Finding ways of remembering names. Keeping better records of email and phone numbers. Respecting my own opinion when I have done the work to back it. Building social relationships as well as professional ones.	Making time to say, 'Hello! How are you?' to creative team members and crew. Researching into the work my collaborators have done – formally and informally – to establish common reference points and potential social connections. Thinking about what the way I dress says about me, and what I want to say by the way I dress.

Table 3 'What works?': analysis of the lighting plan.

What Works?	What Doesn't Work?	What Is Missing?
Using a computer package to generate plots and a linked database of other important information. Changes to the plot reflected in the data file and vice-versa. Can print out new plot on standard A4 colour printer and stick sheets together when necessary.	Channel numbers too small – can't read them under dim work light. *Find out how to make this better.* Default equipment schedule – *need to find a better format* that presents all the useful information in a clear way, both on paper and on computer screen. Final plot is not really user friendly either – find someone who does better plots and find out how they work.	Being able to take the patch file from the drawing package and use it in the lighting desk – *find out how to do this*. Linking the lighting desk to my laptop/tablet – *again find out how to do this and cost*. Can't produce drawings in a format suitable for printing at our local graphics shop – H*ow can I save drawings as* PDF*s on my laptop? Do I really need to produce A1 plans?*

Again, this is a simple but potentially effective analytical tool, but only if it leads to action.

The last tool we will look at is a variation on stop/start/continue. Ask: 'What am I doing now that works?' and 'What am I doing now that doesn't work?' and finally 'What is missing?'

Of course, none of these tools will be of much use if they are only used to look backwards. The reflective practitioner needs to use their reflection to inform future practice, to build on strengths and fill gaps in knowledge and skills. I have introduced *action points* in Table 3. These can be copied into a 'to do' list for personal and professional development. For example:

To Do List:

- find ways to help me remember people's names, and record their contact details;
- make approaches to assist an established LD, to learn more about making useful plots (and lots more);
- research software that links my laptop to the lighting desk.

Any of the above methods could be used to look at your performance in any of the areas outlined in Figure 2, though some will suit you and your practice better than others. Stop/start/continue for research might be just as effective at

highlighting what worked best as the list of questions, and SWOT could be a very useful way of looking at how you are going about building professional relationships.

Phase 2: working in the performance space

Let's look at the LD's activities in the performance space:

If we imagine that the three areas of skill we have talked about – the technical, the artistic and the people skills – occupy different areas of the brain, we can see from Figure 3 that the LD's brain is going to be very busy once the show gets into the performance space. Let's have a look at some of the areas in detail, starting with the focus.

Reflecting on focus and tech

- How well prepared were you for doing the focus? Notes in order, torch, pens & pencils, and water available, names of crew learned and a clear idea in your head about what each lantern would do, for example.
- How well did you manage the focus? Did it all get done? In the allotted time? Without any cursing or cross words? Were you able to be flexible when required; to work round problems such as faulty equipment – continuing to

Technical skills
Artistic skills
People skills
Production Phase: Working in the Space
Updating plans, cue synopsis, and other paperwork
Working with the show-caller/DSM
Building relationships with technical team
Building relationships with technical team
Focusing the fixed rig
Making use of the moving lights
Plotting cues with the programmer
Building relationships with creative team
Realizing the concept
Working as visual dramaturg
Taking notes, receiving notes, working on notes
Ensuring the house crew can look after the show

Figure 3 Some of the activities of an LD in the production phase.

focus other lanterns while one was being fixed, or swapping the function of two units because they happen to work better that way?

- How much of it 'worked' – beams fitting together as planned, covering what was planned, doing what was planned?
- How well covered were you for the bits that you thought might not work? Did they work or not? Should you have tried them out anyway or in retrospect should you have known they could not work?
- Or should you have had more confidence in your idea and not wasted time rigging and focusing a back-up that you didn't need?
- Did you have to go back to any lanterns to re-focus them? How many? Because you got it wrong first time or because things changed? How did you cope with asking the crew to go back to units they had already focused? (It is their job after all.)
- How good were your focus crew? Any whose name and phone number you've got for the next time you need someone good? If you might come back to this venue, it is a good idea to note who does what best on the crew – do you know?
- How well did you brief your focus crew or did you end up working slowly for the first hour while they learned your way of working?
- Did you focus the rig in the right order? If not, why not and what would be the right order?
- Did you have to compromise the focus of any part of the rig? Why (e.g. your miscalculation, faulty equipment, or crew could not get what you wanted)?
- What was the impact of any compromise? How did you cope? Did it turn out to be more serious or less serious than you had first thought?

Some of these questions may seem harsh – and they are. Most performance LDs are freelance workers. They do not have the benefits of a friendly boss coaching and supporting them through difficult times, and helping to identify strengths and areas that need to be worked on. They have to do that for themselves. If you are lucky, you may develop an ongoing professional relationship with someone you do a lot of work with – maybe a programmer, production electrician, director, set designer or production manager – and this person may be able to help you identify the things you are good at and the stuff you need to work on. However, only you know everything about the circumstances of each job. You have to be able to ask yourself hard questions and to answer them honestly: Was the reason that a particular wash didn't work because 'someone' decided to dead[2] the bar at a different height, or because you misread the section or didn't do the beam-angle calculations and just guessed (wrong)?

Let's have a look at another box from Figure 3, notes.

- Do you manage to take as many notes as you would like?
- Have you found your perfect way to take notes? If not, what might help you? How can you access that help? (How much will it cost?)
- Do you manage to prioritize well, taking and fixing the right things first?

[2] To 'dead' a bar means to set its height. As the LD, you need to be involved in all decisions regarding the 'deads' on your bars, and on other flown elements such as masking. There are times when others on the production team may not see this, however.

- How well were you able to stay on top of which cue number the show was in during runs? While you were at the production desk? Away from the production desk?
- How easy do you find it to interpret your notes when you get time to fix them?
- How well did you plan and use the time given to you to do fixes based on notes?
- Were the show-caller and console programmer both clear about what you were asking of them all the time? If there was confusion, where did it come from?
- How long does it take you to locate a channel that is messing up a state?
- How quickly were you able to fix a state that needs intensities to be balanced?
- Same for cue timing? And cue placement?
- How well did you handle notes from the director and others? Were there notes you found it difficult to act on? Were there things that were asked for that you successfully argued against?
- Did you misinterpret notes from anyone else? Why? And what impact did that have on the show? On your relationship with the note giver?
- Is each cue in the show being called correctly? If not, why not? Is the show suffering? Is there anything you can still do about that?

Clearly there are elements of practice touched on here that could be put in other boxes than notes; working with the programmer/operator and with the show-caller/DSM for example, and relationships with other members of the creative team. The point is that many areas of the practice of lighting design depend on each other, affect each other and overlap with each other. Different individuals in different productions will want to ask different questions. By looking at the detail here we hope to find a way of asking the big questions about how well we lit the show, and answering them:

- Does my lighting design support the piece as best it can, given the constraints of time, budget and people available to the lighting department and to the production?

And there is a supplementary to this one:

- What would I have done with more budget and/or time and/or more or different people?

Working as visual dramaturg

With all the other pressures we have mentioned, how well did you manage to keep the 'big picture' in mind?

- How well did I understand and allow my work to be informed by 'telling the story'?
- How well does light help to tell the story? Throughout the piece?
- Did I establish a consistent language throughout the piece?
- If so, how did I get there? What did I do that I could do again next time?
- If not, what went wrong? Did I have good ideas that I was forced to abandon or did I not bring clear ideas to the tech?
- How did I go about using light to help the overall visual dramaturgy?
- Did I make useful contributions to the visual storytelling beyond lighting?

How successfully you can achieve this final goal will depend on many factors. Some of these will really be out of your control, but some may only appear to be. A director with a

very clear creative vision may well have hired the LD only to 'turn the lights on and off when I say', but even this increasingly rare type of director may be persuadable. You might do this directly, through a conversation at the production desk or over dinner. You may do it by showing the director what you mean onstage. You won't do it at all though if you don't have your own strong visual ideas that relate to the text, and have found some way of communicating these.

An LD should always try to be objective about when their contribution is too much. So often onstage, less is more. Leaving something to the imagination of the audience is what makes some of the best live performance work well after all. For an LD, it could be losing some of the set dressing when it does not help with the storytelling – even though it took a long time to focus. It might also be stripping out lighting cues that sounded like a good idea in the rehearsal room but are distracting onstage, or toning down the big sky looks because they overwhelm the performers.

The business of having an influence beyond the lighting can come in many ways, some of which may be surprising to the novice LD. Since many theatre LDs work on many more shows a year than either the directors or other designers they work with, their experience of what works onstage, and what does not, can develop considerably faster than other members of the creative team. It can be further enhanced through watching other productions of as many different kinds as possible. Many more experienced LDs get called upon – formally or informally – to 'direct' complex scene changes for this reason, and because they are usually in communication with all involved in making the scene change happen – show-caller, fly-crew, sound and of course the lighting operators. There are other times when, perhaps for practical reasons, perhaps for aesthetic reasons, the LD's advice is valuable in making changes beyond lighting that enhance the experience of the audience. It may be changes in blocking that not only make the lighting work better but help the storytelling in other ways too, or even changing a line or two to make the storytelling clearer.

How is my career developing?

This can be the most satisfying or the most painful of all the questions to ask yourself after finishing work on a production. If you are serious about building up your reputation to the point where you can earn a living as a lighting designer, or continuing to do just that, it is possibly the most important one.

Making the most of every show

- Do you want to work with any of these people again?
- Do they want to work with you again?
- What opportunities already present themselves to do that? How can you make the most of those? What opportunities might present themselves in the future? How do you stay in touch and 'in the frame' for those future opportunities?
- How can you make the most of this work?
- Have you got good photographs of your lighting? Do you have the right to use those images? Can you put them on your website? On another useful website?
- Is the lighting mentioned in any reviews? (Is there anyone you can get to review the

lighting, e.g. for a specialist publication or website?)

- Is there anyone you want to send reviews or images to? Or bring to see the show? (A potential agent, set, costume or sound designer, or director, you want to work with, or a more established LD you might assist perhaps?)

This last point brings us to the final box in Figure 3: can the house crew look after the show? You don't want to bring people to see a show with your name on it if it no longer looks anything like the way you left it on opening night! While others may take some part in ensuring this, ultimately it is the LD's responsibility to provide the means for this to happen. As the named LD in the programme (and perhaps on the posters too) it is in your best interest to make sure your work looks good for the whole run of the production. Providing a complete, user-friendly 'show bible' with all the important paperwork is only part of the job. Also to be considered are such things as:

- How well will the chosen equipment continue to do its job?
- How easy is it to fix if it does fail?
- Is the cost of keeping the show looking good within the budget of the production?

For example, if the deep-blue gel in the cyc floods needs to be replaced every second show, is there someone with time to do that and is there money to buy the colour media. If a unit is suspended high above the set, can it be accessed for cleaning/re-lamping/re-focusing if necessary, or will it remain hanging but unused should the lamp blow? What impact will this have on the show?

Some people argue that such matters should not concern the LD, and perhaps they are right – in an ideal world. For most of us, however, taking some account of how the design will be maintained does inform our practice.

And on to the next show

Ideally, no sooner has one show opened than the next is on the drawing board, building on the success of yesterday to inform the practice of tomorrow. But an artist should not try to develop in isolation. I would strongly advise going to see the work of other designers, and not just those working with light or in performance. This not only allows a wide range of influences to inform your design practice, but it will give you a growing set of reference points for discussions with the director and other designers of the next project. Remember the questions:

- Am I expanding my own stock of visual reference or continually falling back on what I already know?
- Am I expanding my technical knowledge? Did I try out anything new? Did it work? If it didn't, should I have known/could I have tried it out somewhere else first?

From these two questions arises a third:

- Am I expanding the network of people and/or organizations I work with and for, or continually working with the same few, who at any minute may decide to move onto a new LD, or simply stop making the kind of work I enjoy working on?

And from this question, we should be asking:

- How do I expand the network of people I work with and for?

It may be through doing some of the things mentioned under 'Making the Most or Every

Figure 4 An Association of Lighting Designers social event in London provides an opportunity for students and other people starting out in the world of performance lighting to meet and talk to more experienced professionals. Like most organizations for lighting professionals round the world, the ALD depends on the enthusiasm and energy of its members to make events like this happen. If something like this is not happening near you, why not think about making it happen?

Show' above. It may be through actively approaching new contacts – people or organizations – that you want to work with or for. It may be through trying to secure an agent (though it should be said that in the UK at least most agents for lighting designers don't really get you work). It may be through writing about your work, or by persuading others to write about it favourably. Remember that however you do it, step one is make *contact*.

12

Looking ahead

An alternative title for this chapter could be 'Provocations'. It is not in the nature of any practice associated with live performance to stay the same over time, and lighting design is no exception. In this final chapter I want to provoke a discussion about where the practice of lighting design for live performance might be heading. What follows is meant as an introduction to some of the practices and arguments that will probably be part of the future world of lighting designers, and not a full description of that world. What we are talking about here is speculation on the future and what I want to do is to ask you some questions.

What is the carbon footprint of your show?

Just before the first edition of this book was published, Richard Cadena, the excellent American writer on lighting technology, wrote a piece where he calculated that it takes about one medium-sized bucket of coal to generate enough electricity to run a 1kW lantern for a show. Throughout the last quarter of the twentieth century, the number of conventional lanterns used on a show in London's West End, on New York's Broadway and elsewhere was rising. While in more recent times the unit count may have stabilized, more and more of those units have changed from being conventional lanterns with tungsten-halogen lamps to moving lights with discharge lamps. In Richard Cadena's calculation, he makes assumptions about how much time the 1kW lantern spends consuming electricity – most lanterns spend more of their time off than on, even while the show is happening. Of course, when a conventional lantern with a tungsten-halogen lamp is set at zero intensity, it consumes no electricity. But for a moving light with a discharge lamp this is not true. The lamp will usually be 'struck' and checked before the audience come in. It will then usually remain on until the audience have left – consuming electricity all the while, even when it is at zero intensity. This all goes to explain why the increased use of moving lights, far from reducing the amount of electricity consumed by the lighting rig of large spectacular shows, has increased it. These shows may not need the same peak power demanded by the biggest tungsten-halogen lit stage shows and concert tours of old, but they use more overall, because most of the rig is drawing full power throughout the show, and frequently for a good few hours beforehand too.

The irresistible rise of LEDs

Incandescent lamps are not a very efficient way of producing light from electricity. Most domestic incandescent light bulbs are woefully inefficient, converting around 5 per cent of the electricity they consume into light, and 'wasting' the rest as

heat. Most Western countries have already legislated to effectively ban their use in many settings.

At present (2018) tungsten-halogen lamps for specialist uses – which include lighting for live and recorded performance – are already under threat from legislators in the EU and elsewhere. Commercial pressures too may soon limit the range of available incandescent lamps, and since most lantern manufacturers are focusing their research and development on new lanterns with LED sources, 'conventional' lanterns may soon no longer be made.

In the first edition of this book, published in 2007, I quoted figures for the efficiency of LED compared to other technologies in the table below.

In 2017, it is easy to find white LED lamps for domestic use, quoting a CRI of 90+ and 70+ lumens per watt. That is remarkable progress in just ten years. In this time too, many top lighting designers have come round to using LED as a source. We have come a long way from the early days of the LED fixtures that had poor CRI, unreliable colour consistency and distracting dimming. Today's top specification LED luminaires are rapidly replacing elements of the traditional incandescent fixed rig and the top-end moving lights in almost all performance lighting markets.

LED is not only much more energy efficient than tungsten-halogen lamps, but it is now good

Table 1 Lumens per watt by lamp type

Lamp Type	Lumens per Watt	Notes
Incandescent	7 to 25	The lower the wattage the lower the efficiency, so while domestic lamps are around 7 to 10 LPW most theatre lamps are over 20 LPW (the halogen gas used to fill high wattage lamps helps too).
Compact Fluorescent	30 to 63	It is often stated that compact fluorescent lamps (CFLs) are at least four times more efficient than domestic incandescent light bulbs. Generally there is a trade-off between efficiency and colour rendering index (CRI). Lamps that emit a 'nice' light sit at about 40 LPW.
Standard Fluorescent	30 to 100	These are the long tube lamps seen in any commercial and industrial applications. Again, the highest efficiency lamps emit a 'cold and unfriendly' light. There are difficulties inherent in the way fluorescent lamps work that make them unusable in a focusable lantern. They are difficult, but not imposable to dim, and are used successfully for cyc lighting and soft light.
Metal Halide discharge (e.g. CSI, HMI)	75 to 125	These are the lamps used most often in moving lights, projectors and industrial fixtures. They come in all kinds of different shapes and sizes. CRI can be made be 80 to 90 without too much loss of efficiency, though the most efficient have a CRI around 25.
High CRI White LEDs	15 to 19	This may come as a shock since LEDs are often put forward as super-efficient – and many are – but not yet the white ones. There are problems getting rid of waste heat in any LED fixture since the devices themselves don't work well when they get hot, and this limits the power of any individual fixture.

Figures from General Electric Corporation in 2007.

enough to replace tungsten-halogen in many applications, including some theatre and concert lighting applications. LED challenges the 'it has to be on even when it's at zero intensity' of discharge too. LED fixtures do use some electricity when they are switched on at zero intensity it's true, but nothing like as much as the equivalent fixture with a discharge lamp. LED is already first choice in many architectural lighting installations. It is fast becoming first choice too on the touring circuits and for cruise-ship theatre spaces, where its durability counts for it alongside the low energy draw.

Changing the colour of the key

LED luminaires with good diming and a good full colour range offer a great deal more to the theatre and concert LD than simply using less power. For example, they enable us to change the colour of the key (or the shadow for that matter) without changing where the light is coming from. This can be an immensely powerful tool. Imagine a scene keyed from the pipe-ends in the cool blue/white of a clear, early spring morning. Our scene has strong shadows. Now, imagine that we want to warm up the scene by changing the colour of the key-light to something with more red and less blue in the white. With a conventional rig, we often have two choices – either have a second set of pipe-end lanterns in the new colour that we can cross-fade to, or put scrollers on the pipe-ends. Earlier in the book we discussed the limitations of scrollers, and they hold true here. If you don't have the right two colours in adjacent frames, you will have problems. With a second set of lanterns in a second colour, during the cross-fade there will be two shadows, which can be quite distracting. It is likely that we would increase the fill to dilute the impact of the shadows before making this colour change, just to reduce the distraction caused by having two strong shadows crossfading. With high-quality LED units replacing the conventional pipe-end lanterns, we have no such issues. We can subtly change the colour of the key-light, or the shadow fill light, without losing the strong shadow or them becoming distracting. In addition, we don't have to choose the two colours we are going to fade between days or weeks in advance. Or for that matter be limited to only two colours.

It is true of course that some moving lights with discharge lamps have offered this before too, but for most smaller-scale users, a combination of their size, fan noise and cost have limited their use. The top of the range LED fixtures designed to replace conventional theatre lanterns are not cheap, but the savings in power consumption, gel replacement and re-lamping can make them an attractive proposition.

Pros and cons of large-scale moving light rigs

Many of the largest repertory stages in the UK, Europe and North America have introduced extensive moving light rigs. In the UK this includes all three stages at the National Theatre and the main stage at the Royal Opera House. Before the introduction of moving lights these institutions were often forced to keep the majority of their lanterns in 'fixed focus' positions – providing a general area cover for the whole stage area. The visiting lighting designers had to use these lanterns as the basis for every lighting design, adding a strictly limited number of 'specials' specific to the shape, colour and atmospheric requirements of their show. This was because the institutions could not dedicate the time or manpower to re-focusing large numbers of lanterns every time the show onstage changed – perhaps as often as every day in a

large opera house. Exceptions were made for prestigious shows; for example the management might agree to allow an extensive rig for just one of the shows in the repertory to be mounted alongside the fixed focus rig. (Of course this assumes there is room to do this, and sometimes there was not.) With the extensive moving light rigs now available to lighting designers on these stages, lighting can be made much more specific to the production – to the shape of the setting, to the colours and atmospheres appropriate to the piece. On the whole this has benefited lighting designers by allowing them to extend their creativity outside the constraints of the 'fixed rig'.

However, there are some potential drawbacks to working with a rig dominated with automated fixtures. At present, the first of these is the noise generated by fans used in cooling most of the moving lights presently in use, and by motors, gear boxes and other moving parts. This problem is being addressed by manufactures who are beginning to produce units without fans, capable of very quiet movement. Next is to do with the very discharge source that helps to make these units more efficient: some LDs feel it is not as 'friendly' to their art as the incandescent source of conventional theatre fixtures. As already discussed, it is a different colour temperature and lower colour rendering index – in many circumstances, discharge light does not look as 'nice' on skin and some other materials as incandescent light – and it does not dim in the same way that incandescent light dims. These issues too are being addressed by manufacturers – new lamps are being designed with a more complete spectrum – better CRI – and the new designs for dimmer shutters are addressing many of the concerns of both LDs and technicians.

As already noted, the highest quality LED luminaires go a long way to remove objections based on poor CRI. Some would say they remove such issues from the discussion altogether. Because LED is a lot cooler – temperature-wise – than discharge lamps, LED luminaires can more easily be made without noisy fans. However, this is not always the case. LED does produce some heat, and the chips themselves do not work as well when they get hot, so often some fans are to be found on LED kit.

Another issue, however, is somewhat harder to address. When the director knows there are a lot of moving lights 'that can do anything anywhere' (apparently), their temptation can be to begin to direct the lighting in just the same way as (some) directors direct the performers. This can effectively remove the LD from much of the creative process, turning them into a facilitator of the director's vision rather than a collaborator.

As a creative LD, what you usually want to do is to create light that is in some way consistent throughout the whole show, which has a language that works for every scene. In other words, to light the show as a whole, not as a series of numbers strung together with no overall vision. This is part of the dramaturgical concern we have talked about in previous chapters, and it can be just as important when creating lighting for a concert tour as for a play, an opera or dance piece.

With a good moving light rig, everything appears possible. If you are not careful, it's all too easy to create looks in isolation, with no overall dramaturgical through line – no sense of overall design. While this is not a problem faced by many of us (since there are still relatively few productions with both an extensive moving rig and the time for a director to direct lighting as well as everything else) it has led to some compromised designs appearing on our most prestigious stages, which does little to promote to a wider public the potential power of light in performance.

So here is the first big question of this final chapter:

By making our lighting systems more able to do more things more quickly than ever before, are we as LDs losing control of our lighting?

Digital lighting or projection and video onstage

What is usually meant by digital lighting is using a video projector as the only or primary way in which we light the performers. Digital lighting is not an entirely satisfactory term; we are still searching for appropriate words. But the idea is not that new. Projectors were very effectively used as part of stage design when the media they projected was still analogue film, or even images created by playing with coloured oils in a glass tray on an overhead projector.

What we are talking about here is also called 'projection' and 'video' but both of these words imply something more limited. Whenever we use projected images on stage, or on an LED display screen, we need something to project or display – content. This might be documentary footage, abstract imagery, or the output of a live camera or many other things. On the big budget stage, we have the huge screens behind pop performers including Kylie and Robbie Williams, the CGI[1] scenery of shows such as Andrew Lloyd Webber's *The Woman in White*, and the re-rendered film footage of *Sinatra*. But visual media in live performance is not restricted to big budget shows. Although the largest, clearest, brightest projectors are still very expensive, smaller venues can make good use of something costing less than £1000.

I am not very interested in CGI scenery. To me it is a twenty-first-century version of the painted cloth world that Adolphe Appia and Edward Gordon Craig rebelled against at the beginning of the twentieth century. It is asking the three-dimensional performer to inhabit an essentially two-dimensional world and perform in front of a cinema screen. If a particular audience needs the hyper-reality of CGI let them go to the cinema, where its presence does not compromise the ways in which the performers can be lit. (Think how hard it is to light an actor standing in front of a projection screen – putting enough light on them to ensure the audience can't see the projected image on their face while at the same time not washing out the image of the scenery on the screen.) However, other ways of using what I shall for now call visual media do interest me.

Screens – whether for video or film – have become a commonplace for most audiences worldwide. Onstage, we can use them very easily to show documentary footage that gives a context to or passes comment on the live action. We can use a screen as a window into other worlds, as a comforting reminder of the domestic or as an alienating device. The use and manipulation of images from a live camera on a screen can give the audience additional perspectives on the performers and the performance – a kind of live cubism onstage – or it can give a performer an opportunity to play to (or with) a disembodied version of another actor or even themselves. In the UK, directors Katie Mitchell and Simon McBurney have made a lot of very interesting and often disturbing work that integrates projection and live performance. Typically, this work requires a good deal of rehearsal with

[1] CGI stands for computer-generated imagery – as used in countless contemporary action and adventure films, and also on some live stages.

the technology, and this will inevitably increase the commitment in time of the whole creative team.

Escaping the tyranny of the projection screen

A problem with video images onstage is often the very commonplaceness of the screen – as soon as an audience sees a white or pale-coloured surface, roughly rectangular in shape, there is an expectation that it will soon be filled with images. For the most part, a screen remains a screen for all the time it is onstage, even if at times it has no images on it, and this can be problematic – at least for me as an audience member. The continuing presence of a 'screen' is further enhanced by the 'not quite black' light that most video projectors emit, even when the image is black. This picks out the clearly defined rectangular shape we know as a screen even if the projected image has been cropped to some other shape. This 'ghost screen' remains present in blackouts and has a tendency to draw attention to its self. The audience is reminded of the presence of a screen and the projector and this may not be what we want.

But we can use the projected image as a light source to illuminate something other than a dedicated screen – perhaps turning a tablecloth or a bedsheet into a temporary and impromptu screen. Suddenly there are all kinds of new levels of meaning possible, as well as an almost infinite variation in colour and beam texture. Place a projector in a moving yoke, with pan, tilt, a dimmer shutter and perhaps a zoom lens and beam shaping, and we may have the next generation of moving light. Place a bright enough projector somewhere where it covers the whole stage and you can 'map' images onto any part of that stage. Combine the output of more than one projector from different angles of incidence to the stage, and images can be mapped onto almost any surface that at least one of the projectors can 'see'.

While the big projection shows require significant resources and sizable teams of (expensive) specialists, there is a lot that can be done on a much lower budget, especially if you are working in relatively small spaces – say up to a 100-person audience or so. HD video projectors with an output of around 7000 lumens are beginning to be affordable to small touring theatre companies. A programme such a QLab will run on a Mac laptop, so long as you don't expect it to drive more than a couple of video projectors, and can be licensed on a daily basis, rather than having to pay several thousands for a professional media server.

High-tech seamless screens in specialist plastics can cost a lot of money, and be difficult to tour. Lower-tech solutions include stretching white Lycra material between bodies or posts, slowly revealing the presence of a projected image in a space by filling it with bodies, washing pegged out on a clothes line, or by controlled use of smoke. I've even seen strips of building-site tarpaulin used as very effective large-scale screens. When they were not holding a projected image, they still worked onstage as what they were, evoking building sites and construction projects.

I find it important to have a dramaturgical reason for anything that appears on the performance stage, and the projected image is no different. At the same time, there is room for playfulness in making performance, and the unexpected appearance of a projected image can be part of that spirit too.

So the next big question is:

How might we use the light from projectors and screens effectively as part of a production design?

Can we ever have too much choice?

One of the differences between working with a fixed rig and a rig of moving lights is not so much the increased number of choices available, but the fact that so many choices can be delayed until the technical rehearsal, or even later. With a fixed rig, the focus, colour, beam shape and edge of each unit is set at the focus. To change any one of them during rehearsal requires us to stop rehearsals and get someone up to the lantern to make the change. This encourages thoroughness in preparation – make sure you get it right in the focus or everything else will suffer. With moving lights, it is relatively easy to change a colour, a focus position, a gobo or a shutter cut, from the console, during a rehearsal; so we do. Introducing the possibility of using video content with an almost limitless number of colours and shapes and any static or moving image you can get the rights for presents us with whole new worlds of choice. Making choices takes time, and with this number of possibilities to choose from even getting started can be intimidating – deciding when you are finished can be just as hard. I think the possibilities inherent in all this choice are very exciting, but there are potential pitfalls if the LD abandons a rigorous approach to preparation. Consider this small example.

On an open stage we have a scene set in a cathedral. The production team decide that they would like to set the time and place by using an image of sunlight through a high window somewhere onstage. With conventional lanterns, we might choose to use a glass gobo of a stained-glass window in a good-quality profile from an appropriate angle. The gobo would take some time to research; a high-quality image would need to be found and the gobo produced. This might take several days or even weeks and once the gobo is made it cannot easily be changed. Once the lantern is focused the position of the image on the stage is set – it cannot be changed without somebody climbing up to it and re-focusing it which would take time and stop the rehearsal. The likelihood is that sufficient care would be taken to get this focus right first time. The LD, set designer and director are likely to have collectively thought through the implications of using a particular place onstage. In the tech, the director is most likely to work with this agreed position of the image onstage rather than stop the rehearsal to ask for it to be changed.

If the gobo is in a moving light, we still have to research the image and select one to be made up into a gobo – if we are lucky there may be an opportunity to use up two gobo slots in our moving light and have a choice of gobo. Once we get to the cathedral scene in the tech the position of the image onstage can be decided. If we are not quite happy with the position, at the twist of a controller on the lighting console, the image can be moved across stage to a new position. It can probably be made bigger or smaller too. The LD and director both know this, and so may have only talked in vague terms about a final position – well they didn't need to think too hard about it because 'we can always change it in the space'.

If the image is produced by a video projector, we have potential access to a video designer's entire collection of cathedral windows, from medieval to modernist, stored as static images, or even as movie files. We can re-size them, re-colour them, pre-distort and colour balance them, edit two or more together, all 'in the space'. And this is on top of our ability to move the image to a new place onstage and zoom it larger or smaller. But have we got time to do any of this?

So my next big question is:

Are we more or less likely to make better work with all this choice we can make 'in the space' than we made when we were forced to think hard in advance about what and where the image should be?

Pixel-mapping

I have already briefly mentioned video mapping, using one or more projectors to project a moving or static image onto something. It's a technique that has almost become a commonplace. Large-scale video mapping of iconic buildings is often used for light festivals and commercial product promotion. It is also used on many stages. Here I'm talking about something slightly different. Instead of using very clever software to map the output of projectors to a shape, we can use video images to drive LED panels, or almost any group of fixtures.

The 2011 National Theatre production of *Frankenstein* used pixel-mapping to control the show's spectacular 'chandelier' over the Olivier's open stage. Consider too Kanye West's huge par-can rig for his Glastonbury 2015 set, or the complex LED backdrop for Years & Years' 2015–16 UK and European tour shown in Figure 1.

The LD employs multiple surfaces, often blocks of LEDs rather than projection surfaces, as part of the lighting design. These multiple LEDs are not controlled as individual channels from a lighting desk, but as pixels, each mapped to a virtual screen position. They are controlled by

Figure 1 Years & Years' 2015–16 UK and European tour featured a custom-made LED back wall animated with video content played back on an Avolite Ai video server. (Photography © Scott Davies and Alex Oita.)

data derived from video images, by a media server. The LED blocks, single lightbulbs, or whole moving lights, can be arranged to form a large single continuous 'screen', but it is often more effective to create gaps and spaces in the 'wall of pixels'. The same technique can be used to control individual LEDs in a multi-LED fixture – such as a pixel-line – or a net of LED pixels.

The video information creates an image on that screen – it can be any kind of video image, moving or static. The mapped sources can be arranged as an animated background, or as units providing light onstage, or both. The content displayed may be abstract patterns or moving video footage, including live camera. If seen from far enough away, a reasonable version of the original image can be seen. That is often not the point though. This technique provides the LD with a very quick and simple way of creating patterns across a collection of fixtures. In the case of the *Frankenstein* chandelier, for example, the lighting team were able to create and then edit stunning effects across well over 1000 channels of dimmers in moments – something that would have taken a lot of programming time to do using a more conventional approach.

The possibilities of precision

How much more can the cinematographer do with light than the theatre LD – and usually with far fewer units? Of course with camera we have a single point of view at a fixed distance, and in live performance most often we do not have that. But there is another factor – in film, the performers are much more used to standing where they are told to, moving only when they are told to and looking only where they are told to. If they don't, and because of that the take does not work, then we do it all again. This is a possibility that is not generally available on the live stage. But imagine how specifically and tightly you could light a performer who moved to the same precise spot every night. Generally, dancers do, and perhaps this is one reason why some of the most ambitious lighting on many stages is for dance. Some practitioners have taken this idea even further. International theatre maker Robert Wilson has used tiny beams to pick out just the hand of a performer. Over 40 years ago, Samuel Beckett wrote *Not I*, a play that demands that the only light onstage picks out just the mouth of a performer. The realization that precision has potential is not new, but now we can do things Beckett only dreamed of.

Imagine how you might light a performer whose precise position you could track, and your lights (or a mapped video image for that matter) could respond to each move? Several systems based on radio location or infrared cameras have been developed. The lanterns used to follow the performer in these tracking systems, however, can be anywhere in the rig, for example in places where it would be dangerous or impractical to put a human follow-spot operator. There can be multiple units tracking multiple 'targets' – a big advantage if you have a show in the round for example.

Imagine a system where you could project, say, a single word onto the hand of a performer, and have that word stay on his hand wherever they moved it, as long as it faced the projector. This kind of 'trick' can be accomplished using infrared camera images to control the output of a projector.

Imagine writing lighting cues designed to happen on precise beats of a complex piece of music, not in a regular fashion, but exactly the same every night. No operator could learn the music so well without a good deal of time and training, but if the music is pre-recorded or running to a click track we can make it happen.

The recording needs to have some kind of time code embedded in it. This can then be read by the lighting console. Each cue state is 'stamped' with a specific time from the time code, and each time the music is played – the cues happen as programmed.

The thing about knowing you have a high level of precision available is that you can be much bolder. As an LD, if you know precisely where the performer will be at the moment of the cue, you can light them with a tight special rather than a broader wash. If you know the direction the performer will be facing and the tilt of their head, you can place one or two fixtures to do the perfect job, rather than having to add several more in case they are not doing it quite that way tonight. If you have a tracking system you can trust, you can follow four performers as they run around stage, knowing each will always be lit without the need to 'spoil' your lighting state with a slab of general cover. And if you want to do something for each timpani beat in the finale of *Carmina Burana* it can be a bold statement because you know it will be right on the beat every night. It is not always what you want to do – it is not always what the performance calls for – but when want to be bold you often need precision.

There are two different kinds of thing going on here though. One is using interactivity – information about the exact position of the performer for example – to control some or all of the lighting. The other is making sure everything onstage is as programmed as the modern lighting cue, so that it happens in exactly the same way every night. The first still has the live performer as the trigger for the lighting. The second risks removing at least some of the liveness of the performance. How 'live' is a live show that uses recorded music for example? And is it really any more live when the live musicians are playing to a click-track?

So the next question is:

How do we strike a balance between preserving what is special about a live performance and achieving precision onstage?

Lighting operator as performer

In the tradition of the called show, the lighting operator hits a 'Go' button as instructed by the show-caller. The object is to make sure the lighting is the same every night, and although a good operator can have a small impact at the margins, the scope for being an interactive part of the show is limited. In the concert lighting world, however, the lighting operator is often able to respond in the moment to what is happening onstage; to push a build a little faster, hold a fade a few moments longer, add an extra flourish or most directly, help to stimulate audience response with some extra sweeps and flashes. The lighting operator for a live concert can add something to a performance, and conversely can also take something away from it too – lighting operation as performance.

Follow-spot operators are expected to respond to and be sensitive to the performers they are following. Really tight operation can lift the whole show, both for the watching audience and for the leading performers, just as slack operation can spoil an otherwise strong show.[2]

For a while technology seemed to inhibit the ability of the operator to respond in the moment. The concert LD would stick to running the 'conventionals' on a fader desk, while the

[2] Which does beg the question: why are follow-spot ops often among the worst-paid staff on many shows?

'operator' ran the movers by pressing buttons to playback pre-program sequences. Better moving light consoles and more imaginative programming techniques have enabled the moving light operator to re-engage with their role as performer – and I can tell you it is quite a buzz to get a whole show completely right in the middle of a large and enthusiastic crowd.

But what about the lighting operator as part performer on the dramatic stage? Away from the commercial imperative of the called show, traditions in Eastern Europe evolved that were much more sympathetic to this notion. The lighting men (and mostly they were men) watched the rehearsals and were part of the evolution of the piece over months. Eventually when the piece arrived onstage, they knew it as well as the cast and responded to it with light in much the same way – no fixed cues, no show-caller, no single LD. Well, that's not going to work for us – we will all be out of a job and, in any case, who is going to pay for the lighting crew to sit in months of rehearsal (or even the months of rehearsal)? Is there another way?

The tradition of called shows enables complex performances to happen in a repeatable way, minimizing the risk of physical harm for performers who might be moving between heavy trucks and under flying scenery – but it also restricts the ability of the lighting operator to respond in the moment to the performance, and this is sometimes not necessary.

If the lighting systems were less complex, if the consoles were more interactive, if the theatre operators were more interested in taking on this role – it's a lot of ifs. Would it make for better performance? Better lighting? Almost inevitably some of the time the result would be worse – all performers have off nights and so would the lighting operator. But sometimes it might be better – if the leading lady changes the tempo of her exit and the light changes its tempo to match, or if the leading man delivers a soliloquy from the wrong side of stage but the lighting seamlessly illuminates his new position rather than his original one.

Next question:

Should LDs leave space for the operator in their designs from time to time, with the operator as performer?

Towards more art in lighting for live performance

This discussion began by talking about how much coal (or gas or oil) we burn to make our shows. While some repertory stages have introduced moving lights as part of a programme to save money on running costs, this has rarely been the main motivating factor – and cutting down on power consumption and the amount of waste heat has probably hardly ever been a consideration. But while car and truck makers are being pressured to reduce the impact of their products on the environment and aeroplane travel is becoming as socially unacceptable as smoking in some quarters, how long can we carry on without considering how much CO_2 goes into the atmosphere every time we push up a fader? Should we begin to reject the idea of lighting the stage with lots of lanterns for environmental reasons as well as for aesthetic reasons? In the medium term we have almost certainly already lost the battle to retain large numbers of inefficient incandescent lanterns on dimmers. Even if a new technology provides a temporary stay of execution for the tungsten-halogen lamp, we will probably have to get used to lanterns that don't change colour as they get dimmer – and who knows we might even learn to like that.

Multi-fixture cover systems for lighting the stage grew up around the demands of Broadway and the West End spectaculars, where the LD often had to deal with many different sets,

locations times etc. 'Jewel lighting'[3] developed as a way of coping with these demands. The practice spread to drama lighting where it is probably not appropriate, and even into studio spaces – where scaled-down versions of jewel lighting are not only inappropriate, they don't work.

In the past the practice has been to fill the stage with light from many lanterns combined together to make a wash, and then use relative intensity to guide audience gaze (among other things). How often do we still need to work this way? The design aesthetic on many stages is moving away from cluttered spaces and back towards a more open stage. Do we need a multi-fixture wash for this kind of space? Would it be better to do the washes with fewer large units and use moving lights as specials to guide audience gaze?

The more complex the lighting system the longer it takes to get it in the air and focused, and usually the longer it takes to make the cues. Then there is the thing about too much choice, and finally the potential inflexibility of a complex system – designing out the operator.

If the LD were able to fully participate in the devising of the piece, to offer lighting solutions to the director and others at a point where these interventions could enhance the production without overloading the lighting system; and if there were enough time given to lighting the piece in the space so that each lighting state could find its solution in the right light from the right direction, in just the right colour and at just the right intensity – would we be making progress? And just to say that I think concert LDs should be asking themselves similar questions.

If as LDs we are going to be useful collaborators with our fellow creative team members, rather than technical facilitators, we need to be steeped in the dramaturgy of the pieces we light. To paraphrase many of the LDs I have interviewed over the years, including Dutch LD Henk van der Geest and UK LD Ben Ormerod: **Understanding the piece in the rehearsal room, when you have time to talk, makes you ready to make decisions later – when you barely have time to think!**

If we have to cut down on power, on numbers of units, on incandescent lamps, let's make what we have left work hard for the productions.

Let's have the right kit in the right places, because we share a common vision with all the other creative people making it.

Let's make time to play with light, and with the rest of the things that make up the performances we work on – being a lighting specialist, but also being concerned with always making the best choices for the show.

When we don't have so much time to play, let's be properly prepared to make the scenes we have agreed on (and have a little something ready if one or two of them don't work).

Let's make light work to tell stories, add psychological nuances, paint pictures and sculpt space onstage.

No more turning up to the focus wondering what play we are doing today; no more putting a lantern on every available hanging position 'just in case'.

Let's make creating performance lighting more like making art.

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[3] Jewel lighting is a development, usually credited to Howard Bay, of the approach to lighting the stage codified by lighting design pioneer Stanley McCandless in his influential book *A Method of Lighting The Stage* (first published in 1932). It is essentially a development of the area cover approach. The rig is arranged to enable the LD to light from multiple angles into each area, with a choice of colour and lots of intensity. The object is to be able to make the dramatic focus of the stage picture 'sparkle' like a jewel in its 'setting'. At its best it is an effective and flexible approach to lighting proscenium theatre. It is, however, an approach that uses a lot of lanterns and a lot of electrical power!

Figure 2 Light sculpting bodies in space. Dancers Jonathan Goddard and Gemma Nixon improvising movement in light by Jennifer Tipton.

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